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The Zinc Industry of the Tri-State Field
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An American Engineer's Experience in Russia
By Paris Hiatt

Breaking the Michigan Record in Tunnel Driving
By M. H. Wright and L. H. Geyer

Unwatering the Tiro General Mine by Air Lift
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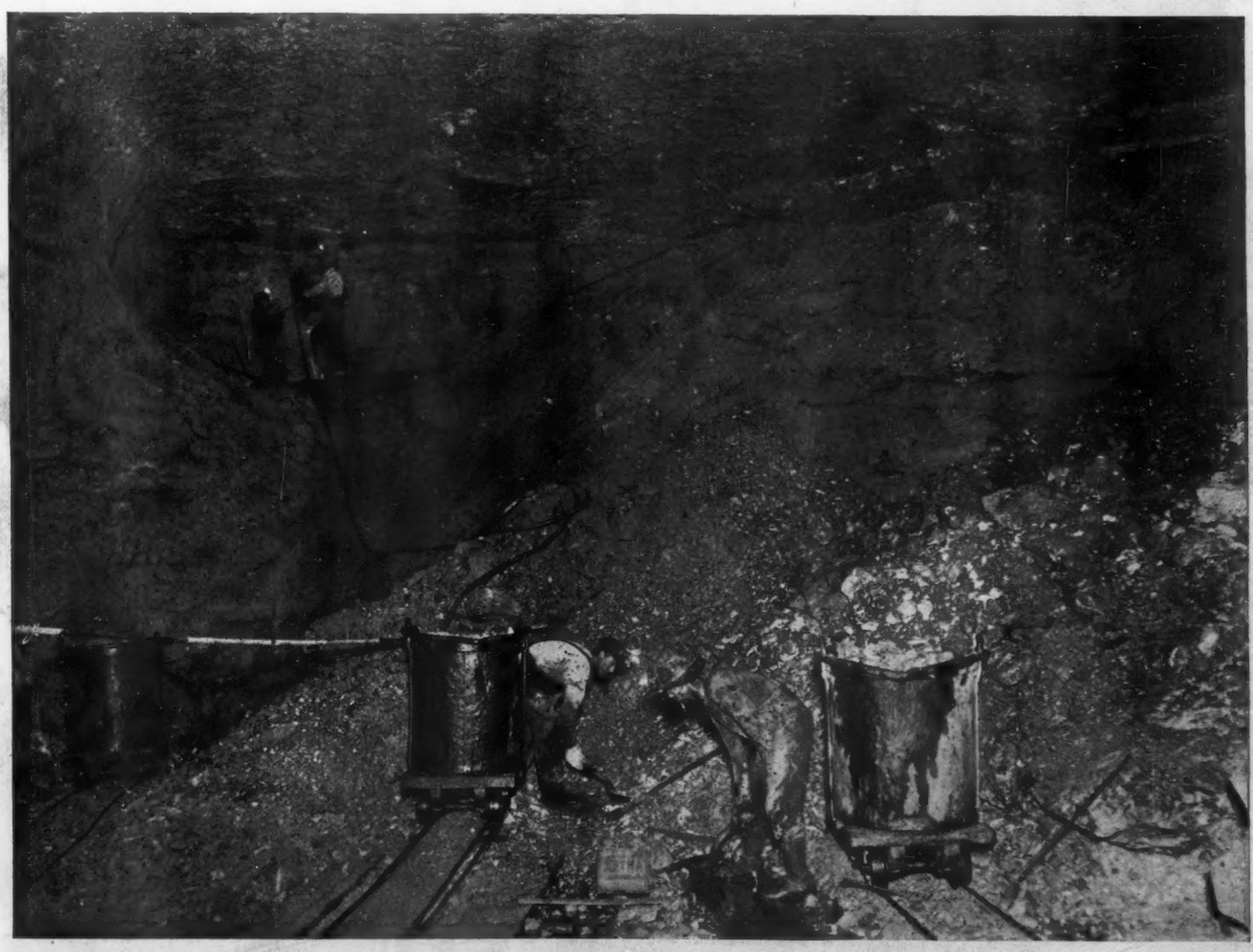
EDITORIAL

United States Rail and Water Routes in Economic Relation



Typical mining in the Tri-State zinc field of Missouri, Oklahoma and Kansas, commonly referred to as the "Joplin District," showing drilling and hand-shoveling of rock. See leading article.

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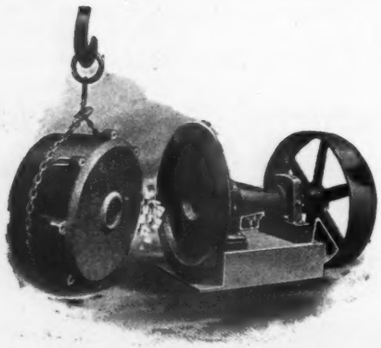

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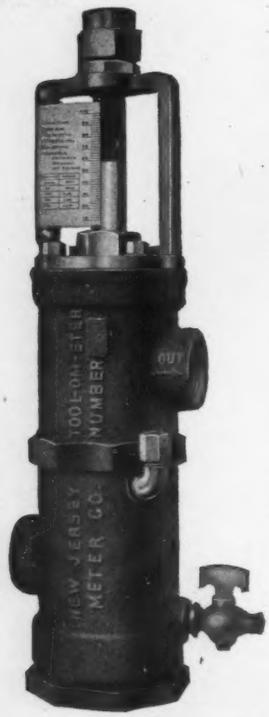

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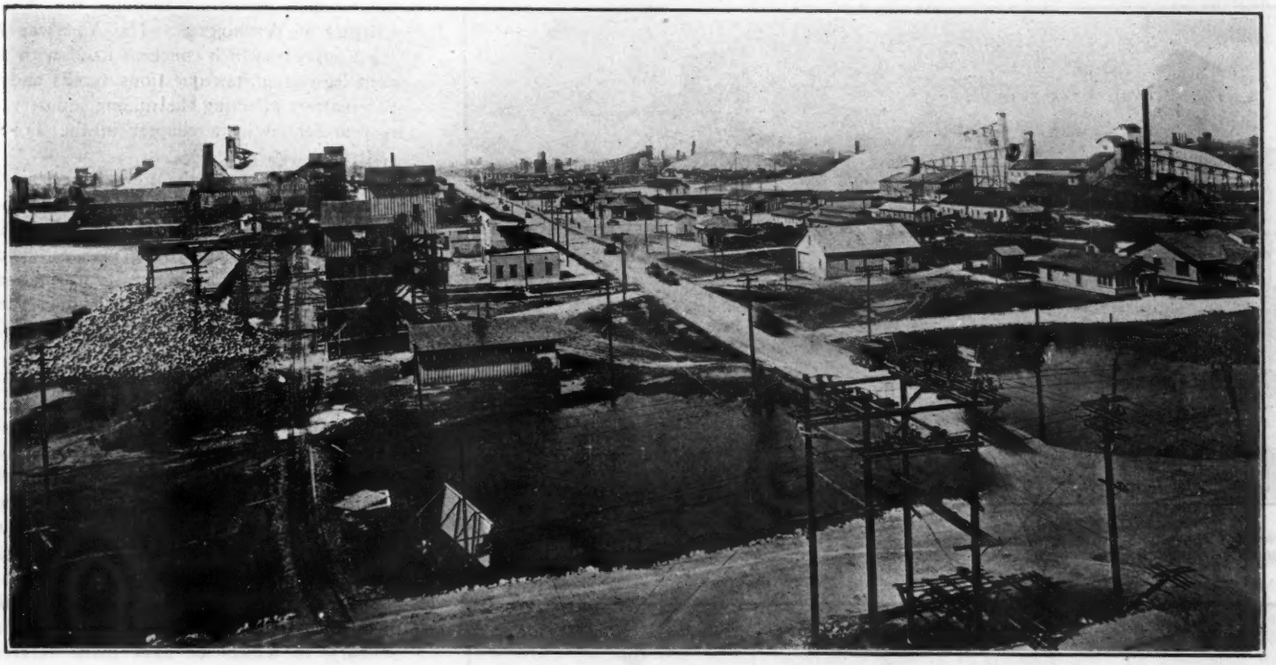
MAY, 1920

The Zinc Industry of the Tri-State Field

Future Production and Marketing Problems of this Important Metal—Mining and the Men Engaged in it—The Affairs of the American Zinc Institute

By FRANCIS JUDSON TIETSORT



A typical mining scene in the Tri-State mining district, in the Picher field, Oklahoma. Note the roads built of "chats" or zinc mine tailings.

THE ZINC business of the United States prior to the European War was not able to compete in foreign trade, nor was much effort made to obtain foreign business. This resulted in stagnation in the development of the new raw crude ore supplies and it had the further effect of fixing a smelting capacity sufficient only for the needs of domestic consumers.

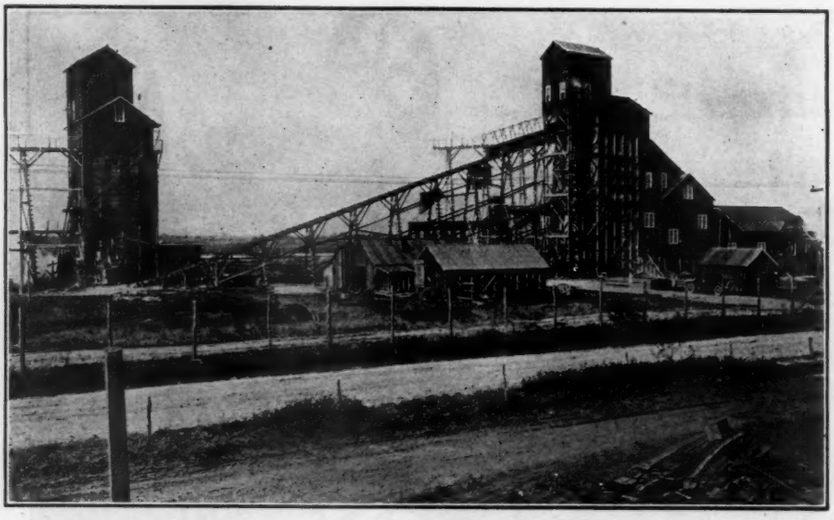
In the course of the Great War it became necessary suddenly for the zinc industry to double its capacity, so that in 1916 there were 200,000 retorts in operation in smelteries as against 100,000 retorts in the latter part of 1914. Roughly about eight tons of concentrates are required per retort per year by a smeltery; therefore 1,600,000 tons of concentrates were required in 1916 to enable the American smelters to serve domestic consumption and the tremendous foreign demand brought about by war conditions.

The smelting capacity was quickly increased, of course, and the great zinc mining districts of the United States simultaneously attempted to increase the production of concentrates to meet the enlarged smeltery capacity. The period of intensive expansion began in 1915 and for three years, approximately, the industry enjoyed its era of greatest development, most extensive production and highest prices. The mining camps sizzled with activity and the smelter men had their heyday.

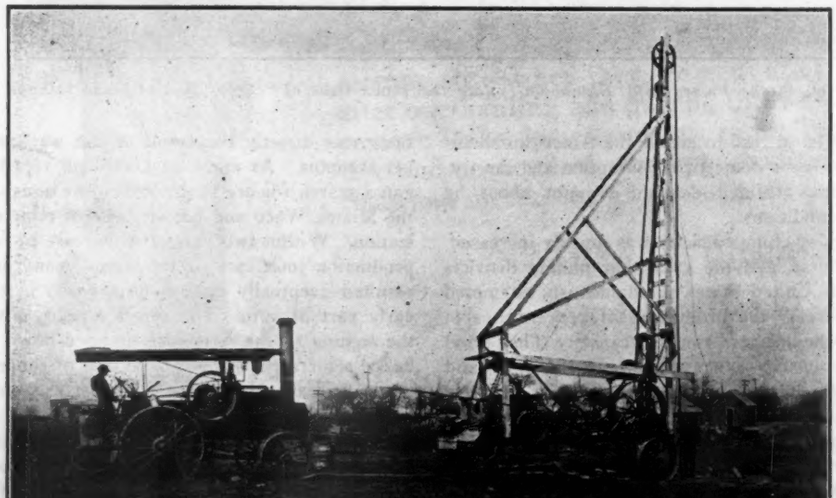
The development of the Oklahoma, Missouri and Kansas zinc fields to their present proportions was directly the result of the war-market stimulus. As many as 1,000 drill rigs began a search for ore in the known ore zones in the Miami, Waco and Baxter belts of mineralization. Within two years the increase of ore production took care of the war demand and resulted eventually in over production in the early part of 1919. The retort capacity after the signing of the Armistice dropped down to 82,000 retorts, requiring 656,000 tons of concentrates, and the Miami district alone was on a basis of 500,000 tons of ore annually.

The necessary reduction in both mining and smelting capacity brought about an emergency which made it of compelling expediency for the zinc industry as a whole to discover new uses for zinc so that at least normal capacity

The Oronogo Circle Mine buildings at Oronogo, Mo. In the fore ground are heaps of chats. These tailings, of which there are millions of tons to be had in the zinc district, can be bought for 75 cents a ton and they make fine railroad ballast, excellent concrete and surface material for highways.



View at the Butte mine in Waco, showing shaft house at left and mill at right. The rock is conveyed up the incline conveyor to the crusher.



Zinc-ground drilling rig driven by a road tractor or harvesting engine.

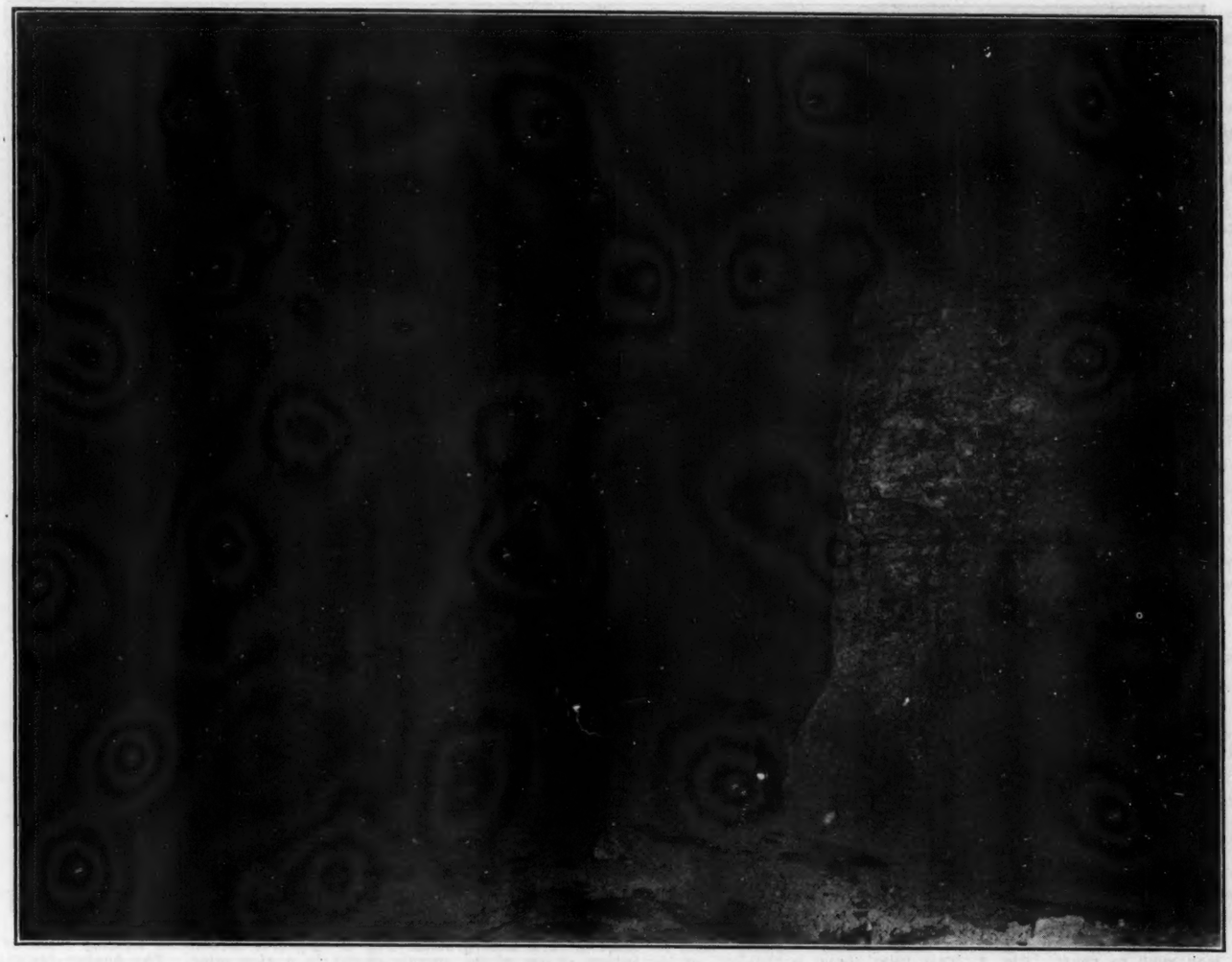
could be restored. There was thereupon formed the American Zinc Institute, Inc., which was laid down along the lines of the American Iron & Steel Institute, which has enjoyed a tremendous success in its field, thanks to the foresight of its active leaders, and their energetic and intelligent methods.

The American Zinc Institute was formed for the purpose of bringing about coöperation and coördination in the zinc industry, including both its mines and smelteries, and also for the purpose of acting as a medium of intercommunication between the various business interests in the zinc industry. In the course of the writer's recent visit to the Missouri-Oklahoma-Kansas zinc field to inquire into future prospects for zinc in America and the present relations between the market for and the production of concentrates, he took occasion to make the acquaintance of the leading mine operators and representatives of smeltery interests, and to observe the workings of the Tri-State Section of the American Zinc Institute, Inc., which functions through the National Chapter at Washington. The American Mining Congress, which concerns itself with pertinent legislation, tax questions, tariffs and similar matters affecting the mining industry, also is represented by a chapter in the Tri-State District.

The organizer of the new American Zinc Institute was a mining engineer known throughout the world of zinc, Mr. Victor Rakowsky, a brilliant young man of dynamic energy, who brought about its formation in 1918. Subsequently he took a leading part in the organization of the American Mining Congress Chapter in 1919. Mr. Rakowsky was born in Duluth, his father having been a patriot who fought in the Civil War. Mr. Rakowsky it was who developed the Butte-Superior mine at Butte, Mont., now owned by the Jackling interests, and the north Miami field.

For many years, as a zinc and lead mining camp, Joplin, Webb City, and Carterville, a triumvirate respectively consisting of a good-sized city and two small outlying towns in the southwestern corner of Missouri, had remained much the same up until the war boom in zinc of 1915, to which we have made reference. While there were a few mines operating in the so-called Miami (Okla.) district, near Commerce, the present Picher field was undeveloped. Mr. Rakowsky, who had had experience in northern and western mining camps, explored the Oklahoma field and had visions of a new mining camp. He believed from the geology of the land that it could be profitably prospected. He blocked out 3,000 acres, and obtained options on the tract on the strength of his faith.

His next move was to find a man with the capital and "nerve" to embark on the enterprise with him and back his judgment. He awakened the interest of Mr. O. S. Picher, of the Picher Lead Company, Joplin, and of the Eagle-Picher smelting and mining interests. In the years 1913-1915 extensive prospecting was carried on, the results being not only satisfactory, but indeed startling. Development of the property was begun by the sinking of four shafts simultaneously, this work being carried



In the old Kansas City-Bradford zinc mine between Webb City and Carterville. This photograph gives an idea of the height of some of the roofs and of the immense quantities of ore removed. A difficult engineering problem has been the removal of the pillars, each of which contains a large tonnage of ore. The operation is dangerous because of caving ground.

on under the direct supervision of Mr. A. E. Bendelari, agent for the Eagle-Picher interests. Mr. Bendelari, of whom more later, became one of the dominating figures in the new Picher camp.

While the recovery from the Joplin sheet ground district had been only at the rate of from two to three per cent in 60 per cent zinc concentrates, the new ground brought out rock that yielded anywhere from six per cent to as high as 25 per cent in rich pockets, and the mining was only slightly deeper. From this early start, the number of mines in the Picher and surrounding Oklahoma field has been vastly increased. The town of Picher, which in 1915 was open prairie, now has a population of 10,000 inhabitants. A new interurban electric line has been constructed from Joplin to Picher and the Mineral Belt Railroad connects the town with the trunk line roads.

While Picher still bears the aspect of a picturesque mining camp of frontier flavor, and four brief years ago, because of its roughness, lawlessness and uncouthness it would have rejoiced the heart of a Bret Harte, a Jack London, a Zane Grey or of a Nick Carter scenario writer, today it has calmed down to a point where gunplays, gambling and dance halls, liquor and vampires have been succeeded by hotels, movies, bungalows, stores, restaurants and even a natatorium. It has many modern conveniences and comforts. The Tri-State Section of the American Zinc Institute has a clubhouse where the operators and their executives, together with the machinery and supply men, hold weekly luncheons into which the unwary visitor in town is trapped to make an address.

The original 3,000 acres and other holdings which were taken up by the mine operators of the district, were in Indian reservations, and so it was necessary to lease the properties from their Indian owners on royalties and guarantees. Many of the Indian owners have become wealthy and it is not an uncommon sight to see a full-blooded specimen of the red race, wrapped in a vivid blanket, racing about the countryside in his big $5,000 car. It is to be feared that some of the less careful Indian beneficiaries of the war-time zinc boom have developed the too-prevalent American habit of extravagance. On the other hand there are others who have seized the opportunity properly to educate their sons and daughters in high grade institutions of learning, and some of these adaptable young folk are to be seen about, garbed in Kolledge Kut Klothes, puffing on bull-dog pipes and wearing class pins.

It was of course natural to expect that for a time the companies which had been mining in the immediate Joplin district would find it difficult to compete with the conditions in the new mining camp over the line in Oklahoma, some 25 miles distant, the result being that during the boom there was a considerable hegira into the newer camp. Entire mills were moved into the new field and during the transition period it was not an uncommon sight to see these mills moving piecemeal to their new sites on motor trucks. The development became so extensive that it became a trite saying that wherever there was a drill rig in 1915 there had now been reared a mill.

We have indicated that there is a problem confronting all hands in the American Zinc Institute and affecting their future business interests. It is appropriate at this point that the elements of this situation be considered, particularly as affecting the particular zinc-producing area of the country which is now under consideration. Practically all development of ore bodies and exploration work ceased when there came a cessation of demand for metal and concentrates. Beginning with

Fig. 1—The celebrated Missouri mule or mine "canary" used for hauling rock underground. Fig. 2—Gasoline locomotive hauling train of zinc and lead rock to shaft. Fig. 3—This view shows a "hooker" at the bottom of one of the narrow shafts in a zinc mine. The hooker fastens the "cans" to the hoisting cable which whisks half a long ton of rock up the average 300-foot shaft with almost lightning-like rapidity. The mines have no ladders in the shafts, and only a very few have skips. The men are carried up and down the shafts in the cans. Fig. 4—Top of shaft house in a zinc mine, where rock is dumped from the "cans" or "jars" on to the "grizzly bars," down which the smaller pieces fall. The larger chunks of rock are broken up with sledges by men who are called "screen apes."

the second half of 1919, a rather brisk export business began to develop, however, and on account of high smelting and shipping costs, the normal Belgian, English and general European production could not begin, and at this writing it is unable to begin production.

A considerable tonnage of metal has gone out through Gulf ports from smelteries west of the Mississippi River that are largely users of Tri-State concentrates. Under this stimulus and with the belief that there is at least two years' business ahead in export which may aggregate as much as a total of 200,000 tons of metal, there has been a resumption of exploration work at three points in the district which were partly developed during the war. These are known as the Baxter, Waco, and Crestline-Badger-Peacock belts of mineralization. These three areas are being developed by the American Metal Company at Baxter, which controls more than 15,000 acres of leases; the Barnsdall & Franks-Dan Glade groups at Waco, and Victor Rakowsky at Crestline-Badger-Peacock controlling 18,000 acres. In addition to these groups many of the operating companies in the Miami district have joined in exploring and searching for new ore bodies in these areas and the state of development at the present time is approximately as follows:

There are 175 mills, with only about 100 in operation due to retardation of demand, and until the demand goes above that for foreign needs and the domestic consumption of zinc is increased, which easily can be accomplished it is thought, provided the American Zinc Institute adopts a strong policy which is contemplated for the next fiscal year, there would be difficulties about opening up other mills. A great deal will depend, the most far-seeing operators agree, on just how effective steps are taken by the Institute to stimulate domestic consumption through a comprehensive plan of widespread publicity and educational measures.

On account of the short-lived leases and the intensive mining conducted in the Miami district, those operators that expect to remain in the zinc business are preparing for the future in replacing the tonnages which are being exhausted in their individual mining operations. They are searching for new belts of mineralization which are proven to exist at the three points indicated. The Tri-State Geological Survey has been formed of geologists of Oklahoma, Kansas and Missouri. The records of exploration and mining operation since 1916 have been brought up to a parity with those of any other mining district in the United States.

Prior to the development of the Miami district practically no records were kept, but with the advent of the larger corporations, such as the Eagle-Picher Lead Co., the Commerce Mining & Royalty Company, the Barnsdall Corporation, the American Metal Company, the Federal Smelting & Mining Company, (a subsidiary of the Guggenheims) the Bilharz Mining Company, the Vinegar Hill Mining Company, and the Admiralty Zinc Company, owned by Cosden, Aiken & Curtis, it has been found not only desirable, but absolutely requisite that such records be made and preserved.

The upbuilding of the American zinc industry depends largely upon the work of the American Zinc Institute, which is undertaking to do three great things not heretofore done by the industry as a whole:

A—Development of the industry and of new uses for zinc.

B—The organization of a great campaign of publicity and education.

C—A complete correlation of statistical information to be intercommunicated between interests in the industry.

In the less than two years of existence of the

American Zinc Institute a multitude of uses for the metal have been found as a result of a partly-made digest of European procedure and through the individual researches of members. One of the great objects of the Institute is to place this information before the trade and the public, to stimulate consumption so that the entire industry will be able to appreciate the great possibilities that lie in the metal. This in itself is a large undertaking.

The total turn-over of the zinc industry in America has been estimated roughly at $100,000,000 per annum, including mining and smelting. The industry, as a unit, has undertaken to double its turn-over by obtaining South American and other foreign business, and through proper publicity it is known and desired that this result may be brought about. The Tri-State Section members of the Institute produce the metal which for the most part enters the trade as "prime western metal" and this is by far the largest tonnage required by the trade. The largest consumption is in galvanizing and sheet zinc. The Institute plans the enlargment of consumption of this bulk production, as a result of vigorous methods, for it is held that in this way only may big tonnage production be made logically possible. The South American galvanizing business offers a splendid field, this business prior to the European war having been controlled by Germany and England. Rightfully and by geographical trade reasoning, the leading zinc operators consider that this South American field belongs in the class of export tonnage west of the Mississippi going out through Galveston.

Three points of intensive development west of the old Joplin district, and which were visited by the writer, are the Waco, Baxter and Crestline-Badger-Peacock fields. A visit to the older Joplin, Webb City and Carterville districts indicated a reviving of industry there, and the Picher (Okla.) field was found to be active, something less than two-thirds of the mills being in operation under existing market conditions.

The writer particularly enjoyed his experiences in the Picher camp, where he went underground, and where the photographs illustrating this article were largely taken, because of its hustling atmosphere, its intensive methods, its peculiar and sometimes laughable mining terminology, and the spirit of absolute democracy between the men and the bosses. Bill and Jim and Ben have small occasion to use surname or prefixed "Mister." It is an All-American camp, and no foreign labor is tolerated by the miners.

It is America's newest and most unusual mining camp, one with all the conventional aspects of the old-time wild-and-woolly West or Southwest, but as indicated earlier in this article, it lacks the usually flaunted effects of liquor and vice. Picher is so near, by automobile and trolley line, that it is really a part of the older Joplin District over the imaginary state line in the extreme southwestern section of Missouri. No visitor, especially if he hail from the "effete East," can fail to be interested and impressed by what he sees both above and below ground. A hundred mills are found here crushing, grinding and washing out the zinc and lead concentrates. The present weekly production from the field is from 9,000 to 10,000 tons of zinc concentrates and about one-fifth as much in lead; this means that about 200,000 tons of rock a week are taken out. The recovery on the total tonnage averages a fraction over six per cent, although many well-faced caves or pockets have been uncovered that have shown returns up to as high as 25 per cent.

I went underground in Crawfish Mine Shaft No. 2 of the Eagle-Picher Mining Company, A. E. Bendelari, Agent, at Picher, Okla., on March 9 of this year, in company with Mr. George Elliott, superintendent, a son of a miner father, who has been in the mining game for 34 years. He came to Joplin as a boy in 1877, where he started in mining in his summer vacations from school. What he does not know practically about the Tri-State zinc mining field as a whole is scarcely worth mentioning, according to his associates at Picher.

We were shot down the narrow six by seven-foot shaft in an ordinary ore bucket operated on a steel wire rope from a highly flexible and active steam hoisting engine at the top of the shaft house. There are no fancy comfortable skips in the zinc mines, for construction is more or less temporary depending on the length of leases. The shafts are vertical, usually drip with moisture, and often pour with it until ground is unwatered or shafts are encased in water-proofing in bad spots.

The shafts average around 300 feet in depth down to the rock that is being worked, in this area, and after one steps out of a 30-in. "can," as it is called, at the bottom of a shaft, whirling dizzily as the rope untwists, he finds it hard for a few minutes in the dimly lit underground regions, to regain his equilibrium. We walked around underground in the various parts of the mine, watching operations for several hours, covering about 40 acres of area. The working temperature underground was agreeable, a little less than 70 degrees. The

Specimen of a Missouri concrete road between Joplin and the southeastern Kansas line on the way to Picher, Oklahoma. This road was built by popular subscription of Joplin citizens. Some pretty brushes between mine operators' speedy cars are to be seen on this straightaway.

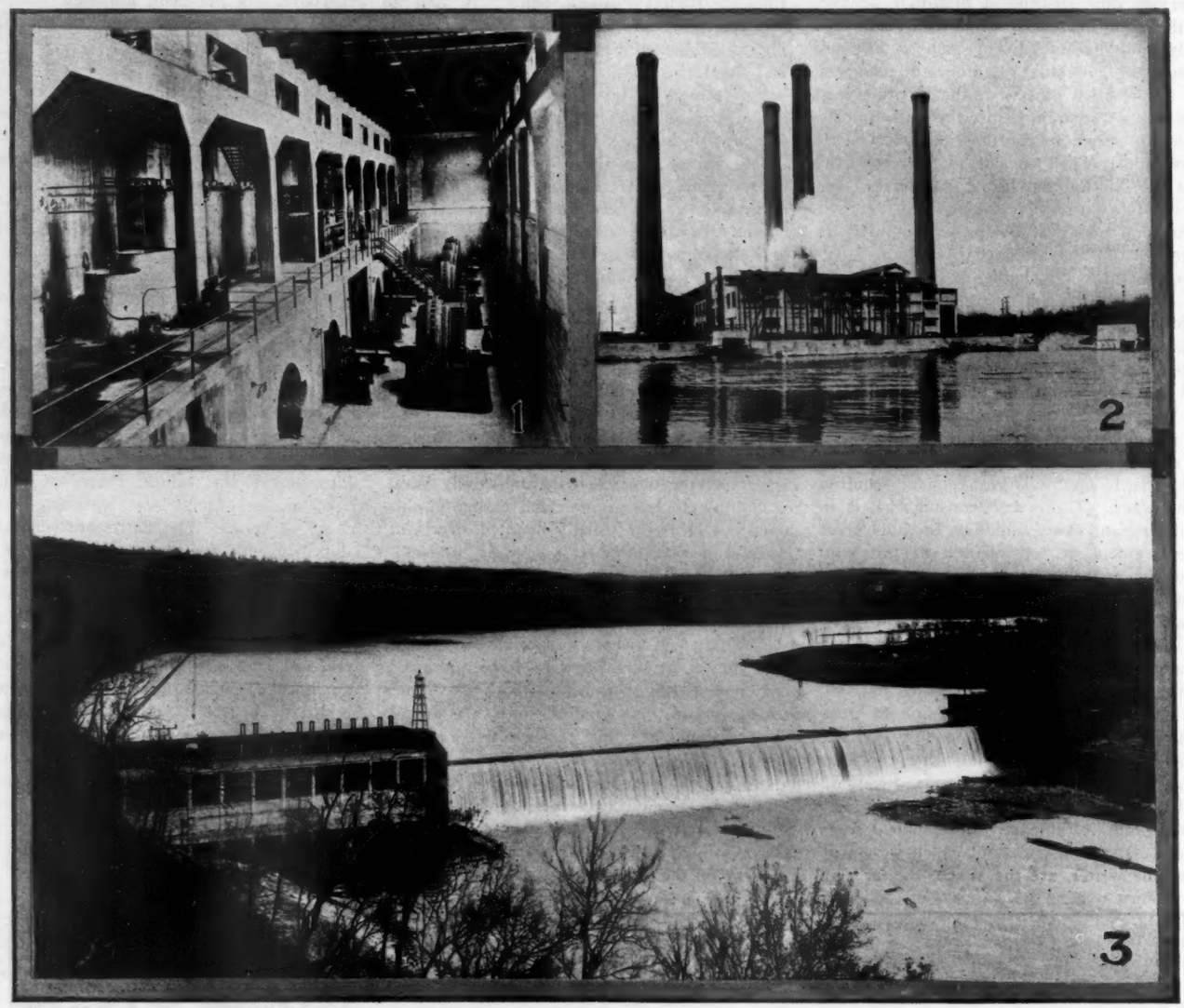


Fig. 1—Interior of Empire District power house showing generator sets. Fig. 2—Plant of the Empire District Electric Power Company, owned by Messrs. Henry P. Doherty & Co., New York, which supplies light and power to the Tri-State zinc district. Fig. 3—Dam of the Empire District Electric Power Co. which impounds water for the turbines.

frontispiece on the cover of this issue of COMPRESSED AIR MAGAZINE will give a very fair idea of mining conditions.

It would be gratuitous to go into a discussion of the unusual mining conditions and methods in Tri-State field, for they are well known and have been described at great length and in much detail in the mining press of the country both from the standpoints of geology and of mining practice. It is sufficient to note that the practice is governed by the conditions such as size of ore bodies and the lengths of the various leases. Under such circumstances it would be foolish for the operators of course to put in the sort of equipment and shafts and structures that one finds for instance in the great copper districts of America, where an appearance of greater permanence is to be expected.

The Eagle-Picher Mining Company has eight mills and 23 shafts in the district. I found the company's air requirements were taken care of by four large and three smaller Ingersoll-Rand compressors. Most of the mining is done in the district with water Leyner drills, and of course there are numerous Leyner drill sharpeners in the district.

The usual mining terminology has been superseded in the Tri-State district by an unique nomenclature which was explained to me by Mr. Elliott. The following is a glossary of terms that will be useful for the visitor to the field to remember:

Can or jar. A hoisting bucket for ore or dirt. Usual capacity from 1100 to 1600 lbs.

Jack. Zinc concentrates. Also erroneously called "ore" in this field.

Chats. Tailings from the mines, or crushed rock residue.

Cokie herder. A shovel boss, in former days he had charge of the grease for cars and pumps. This car grease came in tin cans marked "coco butter," and the grease supply man came to be known as "cokie." When the question was asked of a miner as to how "cokie" was spelled, he replied: "You don't spell it; you just say it!"

Screen ape. A man who breaks up rock with a sledge over the rock screens in the shaft house after it has been dumped from the "cans."

Grizzly bars. The screen over which the screen apes work, so called because rough and tough like a grizzly bear.

Bruno man. A helper shoveller.

Dummy. A helper to a "machine man" or rock drill operator. Why he is called a "dummy," if explained by a drill operator himself would not make fit reading matter for a polite journal. The dummy works on the "storm end" of a drill.

Conditions as a whole are safe underground in these mines, although there are occasional fatalities usually due to carelessness on the part of the men, who like all miners become inured and accustomed to life underground and take chances at times. The operators, however, are coöperating with the National Safety Council and the state and national mining authorities in practical ways to lessen dangers. There have been a few serious cave-ins, but very few deaths from that cause. In one

instance an entire milling plant went down and was swallowed up in the subterranean caverns created by taking out rock—too much of it in that case.

Upon getting ready to go to the surface on the occasion of the writer's visit underground, it was found that the "hooker," or man who attaches the cable tackle to the "cans," had five filled buckets waiting to go up, so we were bidden to wait a moment. We stood a few feet from the hooker looking on. It should be explained that the cans are hoisted the 300 feet to the top of the shaft house, are dumped, and returned down the shaft in 28 seconds, which will give an idea of the speed of the hoisting. When the last of the five cans went up it struck the side of the shaft somewhere midway to the surface, probably not having been started from an exact center, and with a yell the hooker gave the warning to Mr. Elliott and myself, signalling an alarm to the hoist operator above and jumping in a lively manner himself. The brain telegraphs rapidly under such circumstances and in the second interval before the shaft began raining down the heavy chunks of zinc and lead rock, we had leaped to safety behind convenient rock pillars. The falling rock harmlessly bounded past and about us, but cut some of the electric illuminating wires. After a momentary delay we were once more in a can bound upward at a dizzying rate and I confess to a tenderfoot's sigh of relief as I stepped safely out on *terra firma* once more into the dazzling sunlight.

We walked about the town after a weekly luncheon of the Tri-State Section of the American Zinc Institute to observe its whimsicalities and salient features. Some of the quaint signs that greeted the eye were:

Garage and Real Estate; Sam's Barber Shop and Shooting Gallery; Swiss Pool Hall; Kahoma hotel (a combination of the words Kansas and Oklahoma); The Shop that Jack Built (a printing office); Dentist for 30 Days (special prices—crowns reduced from 6 to 4 dollars); The Midway Ice Cream Soda; P. D. Q. Shine Shop; Eddie's Cafe (now dry as the Sahara and serving food and soft drinks); Charlie's Shoe shop and Vulcanizing.

There were half a dozen movie theatres and the ruins of the most pretentious theatre in the town, which had been burned down on the night after its opening by a jealous rival not above incendiarism. His task had been easy because there was no fire fighting equipment in the camp at the time worthy of the name.

A. E. Bendelari, one of the big men of the zinc district, a tireless worker for the Eagle-Picher mining and smelting interests in Oklahoma, over which as legal agent under the state law he has as absolute control as though he were outright owner, has been in the Tri-State zinc country for the last seventeen years. Born a Canadian, in Toronto, where his father was the Italian Consul, Mr. Bendelari went to Cleveland as a youngster and later to Joplin. When the war zinc boom came on he was put in charge of development and production by the Picher interests in Oklahoma.

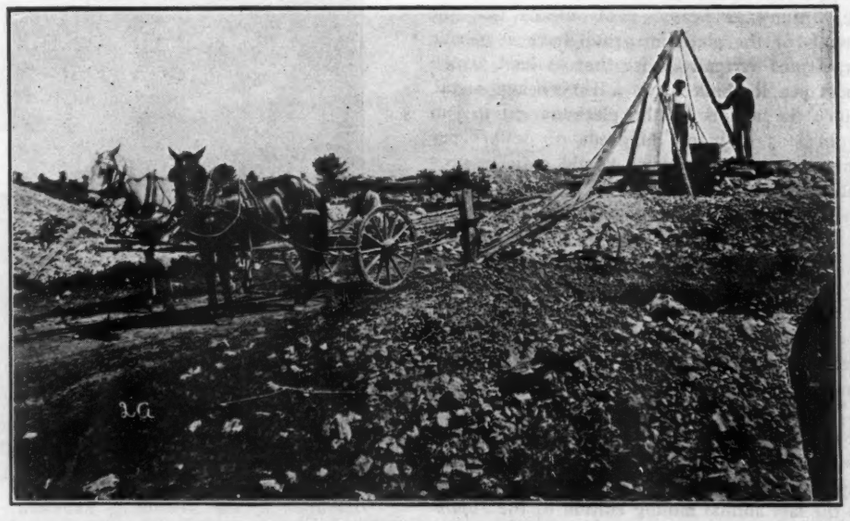
He related to me on a trip to Tulsa and later at Henryetta, Okla., where I visited one of the company's smelteries, tales that were both exciting and droll of the lawless days in the Picher camp of three to five years ago. At that time Mr. Bendelari was the sole representative of law and order in the camp and he put in many busy days and nights. There were murders, drunken fights induced by liquor smuggled in by automobile from Joplin into the dry Indian territory, wide-open gambling, and vice in its many aspects. All this was stamped out by the determined hand of Mr. Bendelari both to protect the better element in the camp from the "bad men" and to insure progress in the great mining undertakings required by war's demands.

The Eagle-Picher interests own three lead smelteries located at Joplin, Galena, Kas., and at Webb City, Mo., and two zinc smelteries at Hillsboro, Ill., and Henryetta, Okla. In company with Mr. Bendelari, the writer had the privilege of spending a day in the Henryetta zinc smeltery and the nearby gas and oil fields from which the supply of fuel gas for the plant, 6,000,000 cubic feet a day, is obtained. Arising in the dark, long before dawn, we drove with Mr. E. M. Johnson, superintendent of the plant, out to the smeltery to see the charging of the retorts, of which there are five blocks, 800 retorts to the block.

The scene as the men "blew out" the retorts with water jets that turned to steam explosions, the showers of superheated metallic sparks from which the thinly clad men, working like demons in a Dante's Inferno, were protected by steel screens, gave one a strong impression of spiked tails, pitchforks and other adjuncts of one of Art Young's interpretations of an orthodox Gehenna. The men worked facing excessive temperatures of from 1,000 to 1,500 degrees Fahrenheit only a few feet from them and protected only by the steel screens. Firing an old-fashioned ocean liner's boilers seemed by comparison a cool job, and yet the men stood up to their work with a nonchalance and a skill that indicated they had become as resistant to fierce heat blasts as a salamander. Following the blowing out of the retorts, there comes the charging process, when men with long narrow shovels, throw the roasted concentrates with wonderful accuracy into the retorts, which, about four feet in length and eight inches in diameter they fill with six or seven strokes of the shovel. Their daily task is ended in from three to four hours.

This smeltery roasts and then smelts about 115 tons of concentrates, or "ore," as they call it in Joplin parlance, daily, which results in from 50 to 55 tons of metal ingots. After the drying of the concentrates, followed by the roasting process, the mixture for the charges is made, from 60 to 65 per cent. of it coal and the remainder concentrates. This mixture remains in a retort six or seven hours, when the metal is drawn off. It is probably the most picturesque and spectacular process of the entire zinc industry.

Zinc melts at 419 degrees Centigrade and boils at 950 degrees Centigrade, the vapor burning in air with a characteristic brilliant blueish-green flame and the production of zinc oxide, a soft, white substance resembling wool. This flame can be seen around the mouths of the retorts in any zinc smeltery where zinc which should be accumulating in the bottom of the retorts is escaping as a vapor and is lost by burning in the air. This is one of the big losses in zinc smelting. The fact that zinc vaporizes at 950 degrees Centigrade, is very detrimental to its smelting, because this is a considerably lower temperature than that of the reaction which takes place in the retort when carbon in the form of coal dust reduces roasted zinc sulphide to metallic zinc. The exceedingly small units required in zinc smelting, the slow improvement in the method of smelting, the fact that the process is intermittent and expensive, all come about largely from the above fact. If the reaction for reduction of metallic zinc could be made to take place at a temperature lower than the vaporization point of the zinc blende (previously roasted down to a one per cent. content of sulphur before being shoveled into the retorts), then the retort method could be done away with and large scale operations conducted in blast or reverbratory furnaces. The blast and reverbratory furnace smelting applied to copper, lead and iron, make possible the low



"Gougers" of the old days hoisting out rock from a small shaft with a small bucket and team of horses.

smelting costs and ease of recovering contained gold and silver.

Zinc, in comparison with the more expensive metals and iron, has a low melting point. For some purposes this is an advantage, for others a disadvantage. Certainly tin and lead melt at too low a temperature for many purposes, and zinc, therefore, holds the advantage over them.

The hardness of zinc is the same as the hardness of galena, which is the principal ore of lead, the mineral being known in this camp as "lead," although it is really lead sulphide. It may be noted that zinc is nearly as hard as copper, gold and silver, and harder than aluminum, tin and lead. In other words, with the exception of iron and nickel, zinc compares very favorably with its competitors. An English author, E. A. Smith, in his *The Zinc Industry*, states that pure zinc is harder than silver. Pure zinc is appreciably hardened by quenching in water after casting. The pure metal is malleable and may be rolled into thin sheets at the ordinary temperature, but commercial cast zinc is moderately hard and brittle at the ordinary temperature. However, it becomes malleable and ductile if heated to a temperature of 100 to 150 degrees Centigrade, after which treatment it retains its malleability when cold sufficiently to admit of being rolled into thin sheets or drawn into wire. In practice, the metal is rolled hot. The tensile strength of zinc is less than most metals, ranging from 19,000 lb. to 28,000 lb. per square inch.

Lightness of zinc is an advantage for most uses. If it were as light as aluminum, it would, of course, be a much more wonderful metal than it is now, but by way of comparison it is lighter than iron, nickel, copper and lead —the only metals which compete with it in a large number of uses. If great weight were the most important of the physical and chemical properties of metals, the metals of the platinum group would be the kings of metaldom.

It should be noted that aluminum is less than three times as heavy as an equivalent volume of water; in contrast, the metal iridium is 22.74 times as heavy as water, and osmium is 22.48 times as heavy. This means that the metals of the platinum group have a specific gravity of virtually twice that of lead, which most people think of as a very heavy metal. Since the metals of the platinum group run from $105 to many hundreds of dollars per ounce in price, the price would entirely prohibit their introduction, even if their extreme weight were any advantage in ordinary uses.

Taking silver as the unit and calling it 100 per cent., the electrical conductivity of zinc is 25.6 to 29.9, and its thermo conductivity is 28.1. If its conductivity were as great as silver and copper, its tensile strength as great as steel, and its weight as low as aluminum, zinc would easily be the king of all metals.

The zinc industry is keenly aware, naturally, of the foregoing facts regarding the metal and its physical attributes, and is basing its campaign of education on deductions from them. In the last annual mining edition of the *Joplin Globe*, published in January, there appeared some ingenious verse by Arthur C. Terrill on the uses for zinc, which are worthy of reproduction:

Use Zinc!—You'll Find It Never Fails!
For shingles, sheathing, roofing, nails;
For flashings, ceilings, gutters, rails;
For brasses, bronzes, batteries, bails;
For boilers, wash boards, dinner pails;
For rubber, barbed wire, foils, flails;
For glues, and dyes, and drugs for ails;
Use Zinc!—You'll Find It Never Fails!

For galvanizing, tubs, and pails;
For sherardizing, coins, and nails;
Desilverizing, paints, and scales;
Electrotyping, tires, and sails;
Precipitating gold from tails;
Preserving wood, and saving jails;
Use Zinc!—You'll Find It Never Fails!

When in the Picher district the writer visited the property of the Montreal Mining Company, of which Mr. C. F. Dike is the general manager. Mr. Dike, who is a Past President of the American Zinc Institute, is in charge of one of the richest mines in the Picher field. This mine began operations with small capital and was made to pay with the use of hand jigs. It is now a well-equipped property.

Hand jigs were seen in operation at the property of the Douthat Mining Co., of which Mr. Harry Wright is the superintendent. The Skelton Lead & Zinc Co. of Picher has seven mills, Mr. Frank Childress being general manager. Here there are twelve air compressors, incidentally, under one roof, nine of them being Ingersoll-Rand XB2 types driven by Bessemer gas engines.

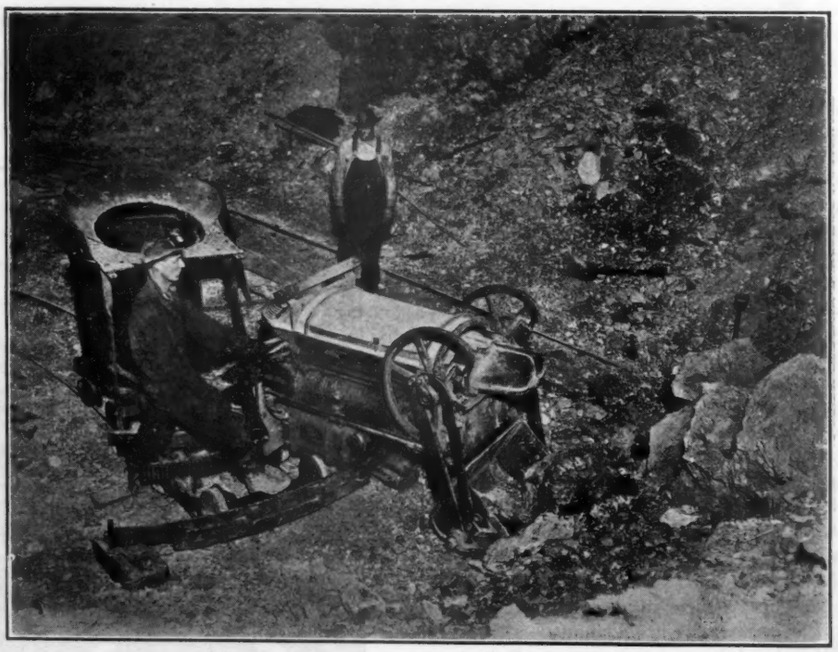
The reader may be interested in other passing comment on companies in the district, many of the properties of which were visited. I had the pleasure of meeting "Mike" Evans, general superintendent of the Keltner Mining Company, who is known as the optimist, or "Pollyanna" of the district. They tell the story of Mr. Evans that one day the brisk Oklahoma wind slammed his office door and broke the glass in it. "There," exclaimed Evans, "I'm glad that happened. I've had a sheet of glass alongside my desk for the last three months and now I've got a place for it!"

Mr. T. J. Rightly is general superintendent of the Chanute Spelter Company, a subsidiary of the American Metals Company near Baxter Springs. The company has been pumping for eighteen months in unwatering new territory in the northeast section of the Picher field preparatory to mining.

The Anna Beaver Mining Company, owned by Buckley Wells, has Lee L. Filius, a native of Colorado and a graduate of the Colorado School of Mines as its general superintendent. Mr. Filius is one of the few men in the field that is using western practice. He has skips in his mine.

The Waco Mining Company at Waco, Mo., of which Mr. P. B. Butler is general manager and Mr. Robert S. Butler general superintendent, was just about to start the most complete steam plant in the Joplin-Picher field. This mine has a great quantity of high grade ore and enjoys a long lease which has warranted the installation of much fine permanent equipment. The power house contains one XPV-3 type Ingersoll-Rand compressor, two 14-inch stroke X-3 steam compressors and seven Cameron pumps, two of which are driven by steam turbines. The exhaust steam from the first-mentioned compressor and the Corliss engine is carried to a General Electric mixed pressure turbine generator set, which is used in connection with a Beyer barometric condenser. This company is now mining at about a 200-ft. level and is going to start a community pumping plan in order to reach a much richer and thicker body of ore between 300 and 350 feet in depth. They have a 1,000-ton mill, one of the largest in the district.

The Butte-Kansas Mining Company, of



Operation of the Armstrong Shuveloder in mucking ore in the Picher district. This machine, operated by compressed air, saves much back-breaking labor and time, and is a decided economical factor.

which Mr. E. Y. Ellis is general superintendent, is another Waco district mine planning on deeper mining. Two of the old mines in the Webb City district that are working are those of the American Zinc, Lead & Smelting Company of which Mr. Ward E. Wampler is manager, which has three and a half per cent. ground, and the Concord mine, which had started up recently at Carterville. Mr. T. F. Coyne had recently made a rich strike near Webb City, when the writer was there, and was developing as rapidly as possible.

The annual meeting in the middle of May in Chicago of the American Zinc Institute is likely to be the most important thus far held, as important questions of policy are to be settled. Mr. Arthur D. Terrill is chairman of the committee on arrangements, with headquarters at 1111 Marquette building, Chicago. Other members of this committee are Mr. Herbert G. Clopper, Chicago; Mr. A. M. Plumb, Platteville, Wis.; Mr. Julius W. Hegeler, Danville, Ills., and Mr. E. H. Wolff, Peru, Ills.

A large attendance is expected at the annual meeting and members are advised to wire Mr. Terrill for hotel accommodations.

Chicago Pneumatic Tool Co. has removed its general offices, effective March 31st, to the Chicago Pneumatic Building, a new ten story structure erected for the exclusive use of the company at 6 East 44th Street, New York.

The Chicago district sales branch, previously in the Fisher Building has been moved at the same time to new quarters on Chicago's new Boulevard Link, at 300 North Michigan Boulevard. The Chicago Service Branch formerly at 521 South Dearborn Street has been consolidated with the sales branch at the new address, occupying the first floor of the building, while the sales offices will be on the second floor of boulevard level.

COMPRESSED AIR USED IN TOBACCO MANUFACTURE

Compressed air has many applications in the tobacco factory some of which are peculiar to the industry and others that have general application to almost any large factory.

A description of these various uses has been contributed by Lewis F. Brown, chief engineer of the R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

The regular tools such as the rock drills for concrete work, and the machine shop equipment for drilling and driving rivets, chippings, etc., and also a few hoists using compressed air are in use but do not require any further mention as they are of standard design. Compressed air is used for blowing motors and machinery in general, to remove the dust, and in places in automatic machines where the fine tobacco droppings have a tendency to gum and clog the machine in a few hours; a fine jet of air was placed to remove this dust, the trouble was removed and the machine could run along its full time.

The same principle is used in another process where it assists in drying and also blows away any dust while a quick-drying paste is setting. This has very extensive application in plants and has made the installation of several large compressors necessary.

In making the "Prince Albert" can tops they are blown clear off the die by air pressure, and just to show that it's an ill wind that won't work both ways, sheets of tin used in making the cans are picked up by means of un-compressed air, or a vacuum.

A battery of boilers is so placed that they are below any drainage or storm sewer line. When these boilers are blown down a few inches under pressure, no complications result, but when they are cooled down naturally, as they should be, and so have no steam pressure on them to blow out their water up to the sewer, a compressed air connection empties them very satisfactorily.

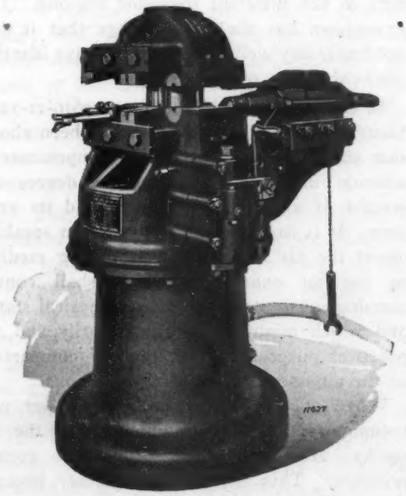
The air is of great use and assistance in spraying liquids for conditioning dry tobaccos. The sprayer acts on the principle of the ejector and will pick up the liquid by suction for several feet rise.

With a pressure reducing valve in series, there is much use made of the compressed air, for the purpose of low pressure control of heating valves, humidity apparatus and similar equipment.

NEW DRILL STEEL SHARPENER

A new compressed air operated drill steel sharpening machine known as the I-R No. 50 Sharpener has been developed by the Ingersoll-Rand Company, 11 Broadway, New York. This machine embodies a number of new and distinctive features some of which are included in the description given below.

This sharpener was designed primarily to rapidly and exactly sharpen and shank drill steel such as: cruciform steel up to two inches in diameter or round, hexagon, octagon, quarter-octagon, auger or spiral steel up to 1⅞ inches in diameter. However, it has performed so many other tasks that "Drill Steel Sharpener" is almost a misnomer. When fitted with special devices, it will forge boltheads, pins, stanchions, etc., in fact, nearly two hundred (200) different products have been made by this machine.



New drill sharpener

The single lever, which controls all of the operations of the machine, is fitted with a safety locking device. This prevents accidents due to the impossibility of operating the machine unless the lock is released—an important feature. The throttle valve is of the balanced spool type, operates easily and quickly, is positive and instantaneous in its action.

The hammer cylinder is an improved valveless type of hammer drill cylinder. This construction permits the free moving hammer to deliver exceedingly fast and powerful blows against the end of the dolly upsetting the steel and so forming the bits and shanks with extreme rapidity. This may be more easily understood when it is mentioned that its capacity is about twenty per cent. greater than the Leyner No. 5 Sharpener.

The base must have sufficient strength to withstand the severe strains and shocks met with in its everyday work. Sufficient attention has not been given to this in the past with the result that base breakage—while not usual—was all too common. A glance at the accompanying illustration will show how substantial and rigid is the base. It needs absolutely no foundation with the exception of a few planks to level it properly and is not even bolted rigidly to them.

Poor lubrication is due most frequently, in the case of sharpeners, to the ordinary exposed sight-feed lubricators being accidently damaged or broken. The Sharpener known as No. 50 has no sight-feed or other exposed lubricators. Efficient and positive lubrication is provided for the entire machine by this company's "Heartbeat" lubricator. This is embodied in the throttle valve chest casting and works automatically whenever the machine is in action. It is provided with adjustment for regulating the quantity of oil desired.

This same idea is carried out throughout the entire machine. Every part is made for long hard continuous service. A more notable example of this is the absolute elimination of all cup leathers. Only accurately machined snap piston rings are used.

AIR MACHINERY EXPORTS

The Bureau of Foreign and Domestic Commerce has provided for publication the following table of exports from the United States of air compressing machinery by countries in the last month for which records are available, January, 1920.

Countries	*Dollars*
France	60,711
Norway	13,158
Portugal	643
Russia in Europe	800
Spain	1,800
England	18,627
Scotland	266
Canada	25,534
Nicaragua	2,159
Mexico	24,266
Newfoundland and Labrador	851
Cuba	10,242
Brazil	686
Chile	2,909
Peru	3,948
China	1,324
British India	3,776
Straits Settlements	129
Dutch East Indies	676
Hongkong	28
Japan	20,072
Australia	19,200
New Zealand	136
Total	211,941

Technology of Air As a Power Medium

Factors and Laws Affecting the Equilibrium of Air—Classification and Industrial Application of Different Forms of Air Power

By J. S. NEGRU
Mining Engineer, New York

WHEN speaking about air-power it is necessary to consider that air as such has no power and is not power. It simply has properties which when acted upon can produce power.[1]

In general any power is not a product existing as such in itself, but merely a result obtained from the reactions following the actions upon the properties of a power producing medium.

This may best be illustrated by two typical examples:

Food in itself has no power and is not power; but when its properties are acted upon by the human machine power is generated—the power to live. Food is the life-power producing medium. Similarly, the water of a waterfall in itself has no power and is not power; but the properties of the water and the physical state of a fall acting upon an appropriate machine—say a turbine—generate power. A waterfall is the hydraulic power producing medium.

These examples have been chosen intentionally because they typify the two classes of jointly or independently required properties of a power producing medium, namely: chemical and physical properties.

Food as a power producing medium undergoes a thorough transformation when it fulfills its power producing action. The resultant product is no more food in the strict sense of the word. Chemical reactions have taken place: the food has been consumed. Food is *chemically* a power producing medium.[2] With the waterfall the conditions are thoroughly different. Here the water does not undergo any transformation during the power producing action. The chemical properties of the water are identically the same before and after the fall; but the physical properties of the water added to the physical condition inherent to a fall constitute the only required properties which when acted upon generate hydraulic power. A waterfall is *physically* a power producing medium.

It is not essentially necessary at present to go into the deails of the theoretical factors involved in the realization of chemical and physical changes to bring forth the facts that it is far easier and cheaper to obtain power through physical changes in the power producing medium than through chemical changes.

Air as a Power Producing Medium

The main power producing mediums are: food, fuels (solid, liquid, gaseous), water and air. The last two are physically power producing mediums. They both present the similitude of being directly or indirectly power producing mediums. Water in the physical state of a fall and air in the physical state of wind are directly power producing mediums because they do not require any additional change in any of their properties to enable them to produce power. In a generalized way it can be said that both running water and air in motion are directly power producing mediums. Water at rest and air at rest are indirectly power producing mediums because they both require some outside agency to act upon their properties before they can produce power. Of these air is potentially the cheapest—due to its being ever present everywhere,—the most useful—due to its valuable inherent flexible natural properties,—the most adaptable—because its natural properties lend themselves to a great range in their changes with an expenditure of a relatively small effort,—and the most efficient—because the cycles of the changes taking place during the power producing actions and reactions leave intact its inherent chemical and physical properties.

Normal Air

The expression "free air" as interpreted by users of air-power stands for the air as such and without its having been subjected to any changes in temperature or pressure other than those due to natural variations of these factors in the different habitable regions. This expression has the disadvantage that it does not imply any well defined and always identical physical status of the air.

In the April, 1920, issue, pages 9610-11-12 of COMPRESSED AIR MAGAZINE it has been shown that small natural variations in temperature or altitude influence to a marked degree the weight of air per unit volume and its pressure. It is therefore necessary when speaking about the air as a power producing medium to use an expression which shall convey simultaneously its chemical and physical status, and which might serve satisfactorily and for practical purposes as the unit of comparison of the air under any and all conditions.

When stating the weight of air per unit volume it is usually accompanied by the remarks: at normal temperature and normal pressure. This is strictly necessary because the weight per unit volume of summer or winter "free air" or of that found at different altitudes is not the same, as can be seen from Figs. 5, 6, 11 and 12.[3]

An expression such as "normal air," i. e., the air which is at normal temperature and normal pressure at sea level conveys a well-defined and always identical chemical[4] and physical status of the body.

For practical purposes "normal air" will stand for air at 60 degrees Fahrenheit (normal temperature) and 14.7 pounds per square inch atmospheric pressure at sea level (normal pressure) and weighing 0.076 pounds per cubic foot. This will be taken as the unit of comparison of the raw material, i. e., the air-power producing medium, in the technical study of air-power machinery and appliances.

The expression "free air" whenever used will stand for any air at rest, i. e., for the atmospheric air at the corresponding local temperatures and pressures.

Absolute Temperatures and Absolute Pressures

It is known that there exists well defined relations between the weight, volume, temperature and pressure of the air. To facilitate the theoretical discussion of these relations it is necessary to have fixed reference starting points for temperatures and pressures.

The theoretical starting point for temperatures is that at which any mass would have neither volume nor pressure.

The theoretical temperature is called the *absolute zero temperature* and corresponds to 491.6 degrees Fahrenheit below the freezing point of water (32 degrees Fahrenheit). When the temperatures are reckoned from the absolute zero they are called *absolute temperatures.* Thus the absolute temperature of the freezing point of water is 459.6 degrees Fahrenheit.

The theoretical starting point for pressures is that corresponding to the absolute zero temperature and is called the absolute *zero pressure.* The pressures reckoned above the absolute zero are called *absolute pressures.* These pressures are expressed in pounds per square inch and are equal to the normal atmospheric pressure plus (compression) or minus (vacuum) the mechanical pressure. Thus: if p_a is the normal atmospheric pressure, and p the mechanical pressure, the value of the absolute pressure P is given by

$$P = p_a + \text{or} - p.$$

The value of p is measured by pressure or vacuum gages, and is also called gage pressure. The absolute pressure is therefore equal to the atmospheric pressure plus or minus the gage pressure.

The value of p_a is 14.7 pounds per square inch at a temperature of 60 degrees Fahrenheit and sea level. For other temperatures and altitudes due corrections must be made. There

[1] In what follows the notion of potential power will not be considered, but instead I will use the expression: properties of a power producing medium.

[2] The physical properties of the food do also undergo some changes, but these changes are merely inevitable results due to the chemical changes.

[3] See Compressed Air Magazine, April, 1920, pages 9610-11-12.

[4] The chemical composition of the mixture called air can be considered proportionally constant under all conditions of temperature and pressure, when the impurities due to strictly local conditions are not taken into consideration.

are tables giving the different values of p_a for different temperatures and altitudes.[5] These corrections are necessary in the calculations of the efficiencies of air-power machinery. The following empirical formula serves to calculate the values of p_a.

$$p_a = 0.491\ h \times [1 - 0.0001\ (t - 32)]$$

in which

h = barometic reading in inches at the local altitude

t = temperature, deg. F.

Kinetic Theory of Air

It has been found experimentally that when two or more gases, which do not react chemically, are brought in contact they intermingle thoroughly. The product resulting from this thorough mixture possesses all the properties of a gas. Air is eminently a mixture of the gases nitrogen and oxygen and acts as a gas.[6]

Although the molecules composing the air are of different natures they obey the fundamental law of gases, namely: equal volumes of air under the same conditions of temperature and pressure contain the same number of molecules. (Avogadro's Law).

A very clear comparison showing the stupendous number of molecules contained in one cubic foot of air at normal temperature and pressure was given recently by Dr. Irving Langmuir at a meeting of the New York section of the American Chemical Society. He stated that if the molecules of one cubic foot of air were changed to grains of sand small enough to pass through a 100 mesh sieve, the sand would fill a trench three feet deep, one mile wide and extending from New York to San Francisco.[7]

These molecules are continually moving with a very great velocity; each molecule moves independently of all the others in all directions and in straight lines. When the air is confined in a vessel the molecules frequently strike one another and also the walls of the containing vessel and thus producing pressure. They also exert a certain reciprocal attraction with a force which depends on the volume, and the specific attraction.

This theory is the fundamental principle underlying the air-power technology. Under normal conditions of temperature and pressure the behavior of the molecules of the air is that of a *normal equilibrium*. A change in temperature or pressure or in both disturbs this equilibrium, and the natural tendency towards the normal equilibrium produces a reaction which is the air-power.

[5] The value of pa = 14.7 pounds per square inch has been determined experimentally as follows: When a long graduated glass tube closed at one end is filled with mercury and brought to a vertical position with the open end immersed in an open mercury bath, the tube will not be emptied, but a certain amount of mercury will still remain in the tube (Torricelli). This shows that the mercury in the tube is acted upon differently by the atmosphere and by what is contained in the tubular space above the enclosed mercury level, and that the action of the atmosphere is the greater. This action is called atmospheric pressure and the height of the column of mercury is the measure of this pressure (barometic pressure).

At normal temperature and sea level this height in a tube one square inch of crosssection has been found to be 29.92 inches. Mercury is 13.6 times heavier than water, therefore if water were used instead of mercury the height of the barometric column would be 29.92 x 13.6 = 406.9 inches (say 33.9 feet) of water. One cubic inch of water at normal temperature weighs 0.03617 pounds, therefore the weight of the barometic column at normal temperature and sea level is

406.9 x 0.03617 = 14.7 lb.

Thus, 14.7 pounds per square inch is the normal atmospheric pressure.

[6] For practical purposes the other gases in the air and its impurities which are always present in small quantities can be neglected.

[7] Chem. & Met. Eng. March 17, 1920, p. 486.

Factors Affecting the Air Equilibrium

Free air is said to be in a stable equilibrium. It has no definite size of its own and fills the space enclosing it. Its molecular energy is at rest.

Wind is the only natural climatic factor which can affect the air equilibrium to such an extent as to generate power. Sailing vessels and wind mills are typical examples of the applications of wind power.

The artificial factors which affect the air equilibrium to the extent of generating air-power are changes in temperature or pressure. This can best be illustrated by the following facts:

When a certain quantity of air is enclosed in a cylinder closed at one end and provided at the other end with an air-tight movable piston so that the enclosed volume of air may be varied at will the following conditions might arise.

1. The piston is allowed to take a position of equilibrium, i. e., a position for which the temperature and pressure and volume per unit weight of the enclosed air are the same as those of the outside air. Under these conditions the pressure at any point in the interior of the container will be the same in all directions and act perpendicularly on the surface of the containers. The piston being subjected to the same pressure from the inside and from the outside will not move. The air is at equilibrium, and as such does not produce air-power.

2. The temperature of the enclosed air is increased or decreased and the piston is not allowed to move. Under these conditions the relative position of the molecules of the air change, and as there can be no change of volume the pressures of the molecules will increase or decrease respectively. These variations of pressure with variations in temperature at constant volume affect the air equilibrium and the tendency towards equilibrium (reaction) produces power.

3. The temperature of the enclosed air is increased or decreased and the piston is allowed to move. Under these conditions the relative position of the molecules change, the pressure on the piston from the inside is different from that from the outside resulting in a displacement of the piston until the inside and outside pressures are equalized. The equilibrium is broken by the variations of volume due to variations in temperature at constant pressure. This finds quite a wide application in generating air-power.

4. The piston is acted upon so as to increase or decrease the enclosed volume. In this case the volume occupied by the enclosed air will be decreased or increased respectively. Assuming that the temperature remains constant the equilibrium is broken by the variations of volume due to variations in pressure at constant temperature. The tendency towards equilibrium (reaction) under these conditions finds the widest application in air-power technology.

Laws Governing the Air Equilibrium

The above considerations show that for air at equilibrium the factors volume, temperature and pressure have well defined values, that when a change occurs in any one of these factors the equilibrium is broken, and, as the natural tendency of matter is towards an equilibrium, there will result a change in another factor (reaction) to counterbalance the first change.

It has been proved experimentally that these actions and reactions obey well established laws.

When P_o, V_o, T_o represent the pressure (absolute), volume and temperature (absolute) of air at equilibrium, the following cases may be considered:

I. The temperature remains constant. When P_o (or V_o) changes, V_o (or P_o) will also change.

II. The pressure remains constant. When T_o (or V_o) changes, V_o (or T_o) will also change.

III. The volume remains constant. When P_o (or T_o) changes, T_o (or P_o) will also change.

IV. All the factors change.

The first three cases cannot be realized with theoretical exactitude in actual practice, but only approximately so. The aim in the study of air power technology is to approach this theoretical exactitude economically and efficiently.

I. Relation between pressure and volume at constant temperature. Law of Boyle (Mariotte).

Let P_o, V_o, T_o represent the initial pressure, volume and temperature of a given quantity of air. When this air is subjected to an exterior pressure p (compression or vacuum) and the temperature is maintained constant, the volume will also be changed. From the very nature of the air it can easily be seen that when p is plus (compression) the volume V_o will diminish and become, say $V_o - v = V_1$ corresponding to the pressure $P_o + p = P_1$, and when p is minus (vacuum) the volume will be increased to say $V_o + v = V_2$ corresponding to the pressure $P_o - p = P_2$.

It has been proved experimentally that the volume of a given quantity of air is inversely proportional to the pressure it bears when the temperature remains constant.

Boyle in England and Mariotte in France have studied this relation and have formulated the pressure-volume law at constant temperature.

$\frac{P_o}{P_1} = \frac{V_1}{V_o}$; $P_o\ V_o = P_1\ V_1$ and $\frac{P_2}{P_1} = \frac{V_1}{V_2}$;

$$P_o\ V_o = P_2\ V_2$$

This equation applies also to the opposite case, i. e., when the volume is changed at constant temperature, and to an increase or decrease in volume will correspond a decrease or increase of pressure.

The general formulation of this law is

$$P\ V = \text{Constant}$$

i. e., *For a given quantity of air at constant temperature the product of the pressure it*

bears and the corresponding volume is constant.

Subsequent work on this subject has proved that $P\,V = c\,t$ does not hold good for very great differences in pressure, but for the practical purposes encountered in compressed air machinery it can be accepted as sufficiently accurate.

II. Relation between temperature and volume at constant pressure. Law of Charles (Gay-Lussac).

Let P_0, V_0, T_0 represent the initial pressure, volume and temperature of a given quantity of air. When this quantity of air is subjected to a change in temperature (heating or cooling), at constant pressure, here also, it can be seen from the very nature of the air that the volume will increase or decrease with an increase or decrease in temperature.

T_0, V_0 initial temperature and volume

$T_0 + t = T_1$ or $T_0 - t = T_2$ and $V_0 + v = V_1$ or $V_0 - v = V_2$

final temperatures and volumes.

$$\frac{T_0}{T_1} = \frac{V_0}{V_1}, \frac{T_0}{T_2} = \frac{V_0}{V_2} \text{ and } \frac{T_0}{T_1} = \frac{V_0}{V_1}, \frac{T_0}{T_2} = \frac{V_0}{V_2}$$

Charles in England and Gay-Lussac in France have studied these relations and have formulated the following law:

For a given quantity of air at constant pressure the volume is proportional to the absolute temperature, i. e., the ratio $\frac{T}{V}$ is constant, in which T is the absolute pressure and V the corresponding volume.

III. Relation between temperature and pressure at constant volume.

What has been said about the relation between temperature and volume at constant pressure applies also to the relation between temperature and pressure at constant volume.

Thus, if T_0, P_0 are the initial temperature and pressure and $T_0 + t = T_1$ or $T_0 - t = T_2$, $P_0 + p = P_1$ or $P_0 - p = P_2$ the final temperatures and pressures

$$\frac{T_0}{T_1} = \frac{P_0}{P_1}, \frac{T_0}{P_0} = \frac{T_1}{P_1} \text{ and } \frac{T_0}{T_2} = \frac{P_0}{P_2}, \frac{T_0}{P_0} = \frac{T_2}{P_2}$$

i. e., $\frac{T}{P}$ = constant.

For a given quantity of air at constant volume, the absolute pressure is proportional to the absolute temperature.

IV. Relation between temperature, pressure and volume of air at equilibrium. Characteristic equation of air.

This case is realized by combining the laws of Boyle (Mariotte) and Charles (Gay-Lussac).

Let P_0, T_0, V_0 represent the initial pressure, temperature and volume of a given quantity of air.

With T_0 constant and changing P_0 to $P_0 + p = P$, according to the law of Boyle (Mariotte) the volume V_0 will become $V_0 - v = V_1$ and

$$P_0\,V_0 = P\,V_1 \quad (a)$$

The air is now at pressure P, volume V_1 and temperature T_0. By applying the law of Charles (Gay-Lussac): change of volume with the temperature at constant pressure, to a temperature $T_0 + t = T$ will correspond a volume $V_1 + v_1 = V$ and

$$\frac{T_0}{V_1} = \frac{T}{V}; \quad T_0\,V = T\,V_1 \quad (b)$$

From (a), $V_1 = \frac{P_0\,V_0}{P}$ and by substituting in (b)

$$T_0\,V = T\,\frac{P_0\,V_0}{P}; \quad P\,V = \frac{P_0\,V_0}{T_0}\,T.$$

$$\frac{P_0\,V_0}{T_0} = R$$

and $P\,V = R\,T^*$ (c). $\frac{P\,V}{T} = R = \frac{P_0\,V_0}{T_0}$ = constant.

This is the characteristic equation for air, and the value of R is 53.34.

Industrial Applications of Air Power

From what precedes it is seen that the air possesses the valuable properties of fluidity, elasticity and expansibility. To these can also be added, amongst others, the properties of buoyancy and change of state (liquid air). All these properties are applied now quite extensively for generating air-power. The types of machinery and apparatus for the production and uses of air-power are rapidly increasing and varied.

The industrial applications of air power are limitless.

A very convenient classification of the different forms of air-power and their industrial applications is based on the particular air property used in the production of the power.

Thus: 1—Wind Power (fluidity)—Sailing vessels, windmills, etc.

2—Hot air power (expansibiltiy)—Hot air engines, etc.

3—Compressed air and vacuum power (elasticity—Compressors, etc.

4—Aeronautics (buoyancy).

5—Liquid air (change of state).

These classes are not strictly distinct because the properties of the air are correlated to a more or less degree and not thoroughly independent; but for practical purposes this classification divides quite satisfactorily and in a general way the subject of air-power technology.

[The next article will contain a succinct historical review of the different classes of air-power, machinery and appliance.—*The Editors*].

*The laws of Boyle (Mariotte) and Charles (Gay-Lassac) are not theoretically exact, therefore the characteristic equation P V = R T, which is a deduction from these laws, is also theoretically inexact. For the present this equation can be considered sufficiently accurate for practical illustrative purposes.

Personal Intelligence

Robert H. Chapman, of Washington, D. C., a widely known topographic engineer, died of pneumonia in New York recently at the age of fifty-one years. He was educated at the Corcoran Scientific School in Washington and had been connected with the New York Geological Survey since 1880, with the exception of three years. He made surveys and explorations in Western and Southern States, maps of Death Valley and adjacent deserts and the high Sierras until 1909, when he went to Canada to introduce the United States topographic methods there, and served in various parts of the dominion, residing two years on Vancouver Island and British Columbia. Mr. Chapman later rejoined the coast survey. He was a member of the American Institute of Mining and Metallurgical Engineers and connected with numerous other scientific bodies.

* * *

Willis E. Martin, treasurer of the H. K. Porter Company of Pittsburgh, and for 44 years connected with that company, died on January 12, after a prolonged illness. Mr. Martin had hundreds of acquaintances and friends throughout the mining, manufacturing and railway industries of the country and will be sorely missed by his associates of the H. K. Porter Company, among whom he had many close personal friends.

* * *

Theodore Douglas, consulting engineer, president of the Hudson Equipment Corporation and Duplex Engine-Governor Company, died in his fifty-first year. He was graduated from Yale in 1894, spent three years in Italy in archaeological research, and later traveled extensively in this country and Central America as an expert for metallurgical and mining companies.

* * *

Lindon W. Bates recently addressed the Metropolitan section of the American Society of Mechanical Engineers on the subject of "Collaidal Fuel." At the same meeting the following papers were presented: "Fuel Oil" by Mr. E. H. Peabody and "Pulverized Coal" by Mr. C. C. Trump. The programme offered an unusual opportunity to the engineer to learn recent developments in fuel practice.

* * *

Malcolm M. Thompson, geologist to the Standard Oil Company of New Jersey and the Carter Oil Co., died recently at his home in Morsemere, N. J. He was 33 years old. Mr. Thompson was a graduate of the Columbia School of Mines and after traveling extensively in Central and South America he went to Chili with the Guggenheim Exploration Company. He was a member of the American Institute of Mining and Metallurgical Engineers.

* * *

Guy E. Norwood, former secretary of B. F. Goodrich Co., tendered his resignation as president of the Republic Rubber Co. of Youngstown. He will remain as director of the company.

E. F. Jones, formerly of the Elyria Iron & Steel Co., was elected to succeed Norwood. The latter has been in charge of the Republic since June, 1917.

* * *

Miss Kathleen Patricia Leahy, who had previously resigned as secretary of COMPRESSED AIR MAGAZINE, was married at New York on April 14 to Thomas Aylette Buckner, Jr., son of the vice president of the New York Life Insurance Co.

Breaking the Michigan Record in Tunnel Driving

More Than Nine Feet of an 8 x 8 Tunnel Driven Every Eight Hours at the Holmes Mine in Ishpeming—Character of the Rock Formation and Average Advance per Day

*By M. H. WRIGHT and L. H. GEYER**

MINERS believe in miracles because they perform them, although, to the miner, these are all in the day's work. Stories of rock drilling and hardrock mining have never lost their fascination. There is something about delving into the bowels of the earth in search of nature's treasure that appeals to the layman, whose knowledge is confined to what he has heard or read. Today mining holds forth more than ordinary appeal, for the value and quality of the work going on thousands of feet underground is a real indication of the proper kind of Americanism. Some remarkable achievements in driving hardrock tunnels and mine drifts have been made possible by constant improvement in mining methods and in the construction and design of the tools used. Many times in the past the Lake Superior district has set the pace for this class of work, but nothing has equaled the drifting accomplished at the Holmes mine, one of the Cleveland-Cliffs Iron Co.'s properties situated at Ishpeming, Mich. Here an 8 x 8-ft. tunnel has been driven at remarkable speed, the record advance being 484 ft. in 432 hours' working time. This betters a previous record of 348 ft. made in 342 hours.

The rock is diorite, dense and hard, a phase of massive greenstone. Some idea of its hardness is shown by the fact that 80 per cent. gelatine was used for blasting. The daily working time was sixteen hours, being divided into two eight-hour shifts. Each shift crew totaled ten men, consisting of four miners and six muckers and trammers. No. 248 Leyner-Ingersoll drills, equipped with anvil block chucks, were used exclusively for the drilling. These machines were supplied with 1¼-in. hollow hexagon steel having four-point cross-bits, all of which were machine sharpened. Starters were 24-in. long with 2¼-in. gage, and this was reduced 3/32 in. with each 18-in. change in length of steels.

As stated above, the tunnel drift is 8 x 8 ft. The standard "V" cut was used in drilling, requiring from seventeen to nineteen holes, or more than 100 ft. of drilling per round. Two machines were mounted on a shaft bar, three set-ups being necessary for one full cut of 9 ft. Two top cuts were drilled and blasted before shooting the bottom holes.

During the month of October, 1919, the working time totaled 432 hours, and during this time the progress was 484 ft., or 9 ft. every eight hours, reducing to 24.2 ft. advance per man employed. This not only involved the drilling, blasting, breaking and tramming of 30,976 cu. ft. of rock, but the hoisting thereof to a height of 1,300 ft. and its disposal from that point. All of this work was under the direction of Superintendent Lucien Eaton and Captain William Tramblin, who organized and directed the work. Too much credit cannot be given to them and the crews for the splendid record and its consistency. In another mine, before the installation of the most modern drilling equipment, an eight months' run of 420 ft. average was maintained, one month showing an advance of 464 ft. in 448 hours. When the new machinery was introduced the time was reduced 25 per cent. In this case, the ground was somewhat softer than the diorite, but required no timbering. This and the recent record of 24.2 ft. per man per working month in diorite with Leyner-Ingersoll drills recall other recent results obtained with similar drills in the same district. These performances are summarized thus: 21 ft. per man per month average for eight months in slates; 25.1 ft. per man in slates and graywackes; 26.9 ft. per man in slate and graywackes. Comparisons do not give correct conclusions, as the differences in mining stratified ground and igneous rocks of different hardness have so much to do with the progress made that little comparison value can be attached to them. The interest lies in the fact that such good results have been achieved by using modern tools and methods.

Whether the record of 484 ft. can be exceeded with equal conditions is doubtful, but the introduction of a mechanical loader has already opened up efforts to considerably exceed this figure. There can be little doubt that the results will be bettered, for the time interval required to load broken rock in cars by hand is a large percentage of the total time required. The mechanical loader should reduce this time and increase the total working efficiency.

Drift Heading at Holmes Mines, Ishpeming, Mich.

*Reprinted from Engineering and Mining Journal.

MOIR, CHAMPION RIVETER, WINS BRITISH HONOR

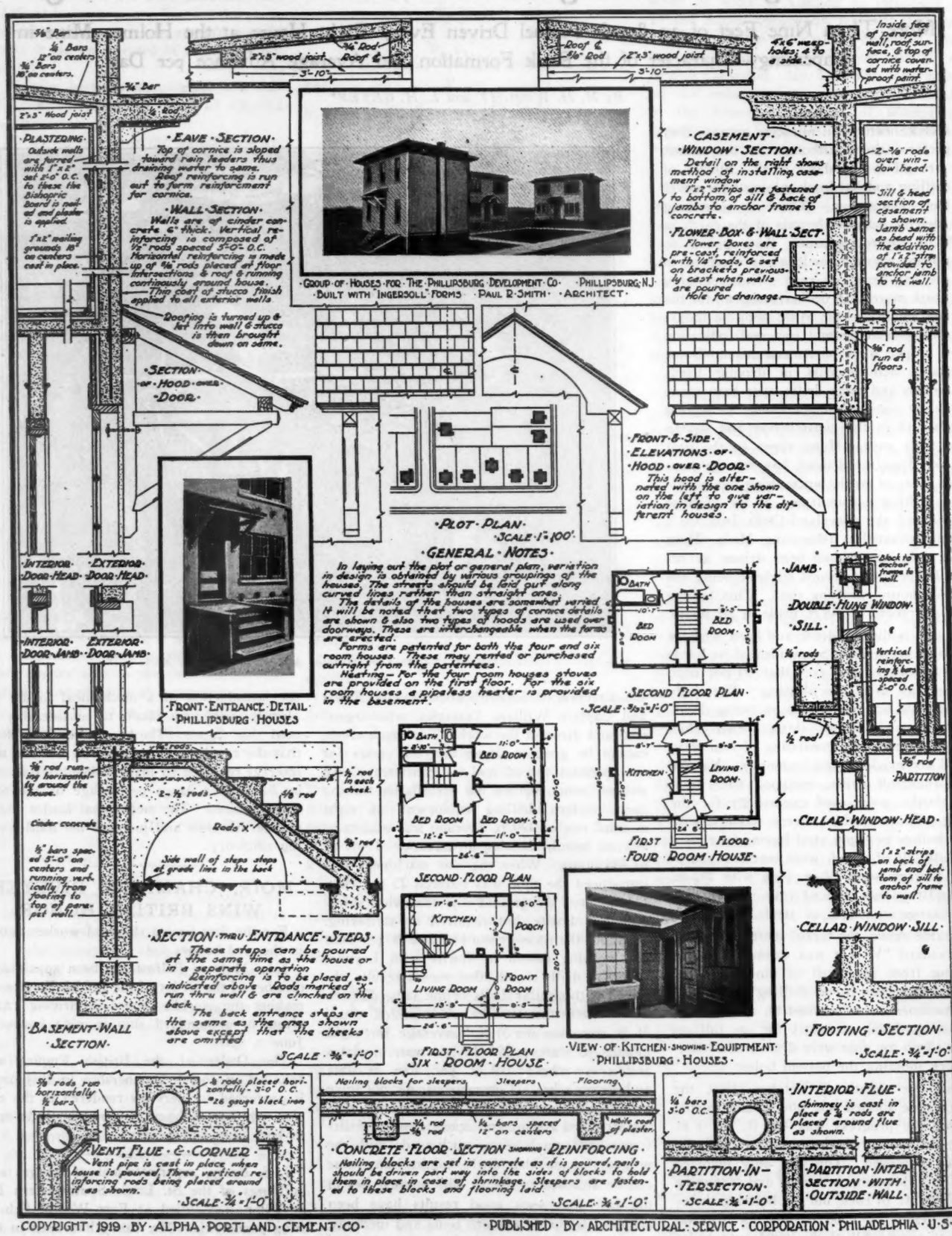
For the first time a shipyard worker figures in the civil honors list.

John Moir of Belfast has been appointed a member of the Order of the British Empire for making the world's record in driving 11,209 rivets in a standard ship in nine hours on June 5, 1918.

The Order of the British Empire was founded in 1917. Membership in this order is conferred for services rendered to the empire, whether at home or abroad. It is open to both men and women.

J. S. Berry, superintendent of bridges and buildings of the St. Louis Southwestern Ry. at Tyler, Tex., died at Fort Worth, Feb. 9, from pneumonia. Mr. Berry had been in the service of the St. Louis Southwestern for more than 25 years.

Working Details of Construction of Ingersoll Moulded Houses



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Service sheet of the Alpha Cement Co., Easton, Pa.—The Ingersoll-Rand Co., New York, has built about 70 houses at its Phillipsburg, N. J., plant according to these plans.

Comfortable and Permanent Industrial Homes of Concrete

A Description of the Method of Rapidly Constructing Four and Six Room Houses at Phillipsburg, N. J., for the Phillipsburg Development Corporation

A DESCRIPTION of the industrial housing project sponsored by the Ingersoll-Rand Co. of New York for its factory employees at Phillipsburg, N. J., through what is known as the Phillipsburg Development Corporation was given in the January issue of COMPRESSED AIR MAGAZINE. *This second article, excerpted from Alpha Aids contains additional data and photographs which were not obtainable at the time of publication of the first article. The working detail drawings were prepared by the Alpha Portland Cement Co., Easton, Pa.*

A COMMUNITY consisting partly of a comparatively new type of concrete house is being established by the Phillipsburg Development Corporation near the big Ingersoll-Rand Works in Phillipsburg, N. J., and it is an enterprise that is well worth the inspection of any manufacturer or municipality interested in housing projects.

The type of house is that shown by the illustrations accompanying this article. This house is known popularly as the Ingersoll type, because of the fact that Mr. Charles Ingersoll, of Dollar Watch fame, who has been greatly interested in housing projects for a number of years, is largely responsible for the particular type of construction. Certain patents covering the forms used in building the neat little homes are controlled by Mr. Ingersoll and his associates. However, there is nothing secret or mysterious about the method of building, and it is one from which any contractor or property owner may well take lessons. A number of these houses have been built in different sections of New Jersey. The general opinion is that they are admirably arranged, considering their size and that they represent close to the maximum of value for the cost. Before labor and materials took a big jump, the cost of these houses in the four-room type was figured at about $1,000 each. It is not, of course, expected that they could be built today at such figures, but it is fair to say that in the Phillipsburg work the costs are running well below $2,000 per house, including plumbing, doors, painting, etc., but not the value of the land.

The original houses of the Phillipsburg Development Corporation were all of the four-room type. Since that time a number of the six-room houses have been erected, which makes it possible in this reprint of the original information to include further details about the six-room house. The total cost of a six-room house was $2,512. This total is for material and labor only, but an idea of the total cost of the construction may be gained from the fact that the Phillipsburg Development Corporation was under agreement in 1919 to furnish the six-room houses to Ingersoll-Rand employees at $3,250 (the actual cost of the house land, etc., complete). This concrete house colony is within a few blocks of the well-known plant of the Ingersoll-Rand Company. It is the programme of the Phillipsburg Development Corporation to erect a total of 60 or 75 houses of the two sizes.

A number of economies have been effected during the progress of this work through the standardization of everything entering into the house. The mill work for each house of a given type is the same. The rough work on the plumbing end comes to the job assembled ready to be put right into the forms. It has been found that even in the plastering, as the men go from house to house and become familiar with the treatment of the surface, it is possible to save time in the actual work.

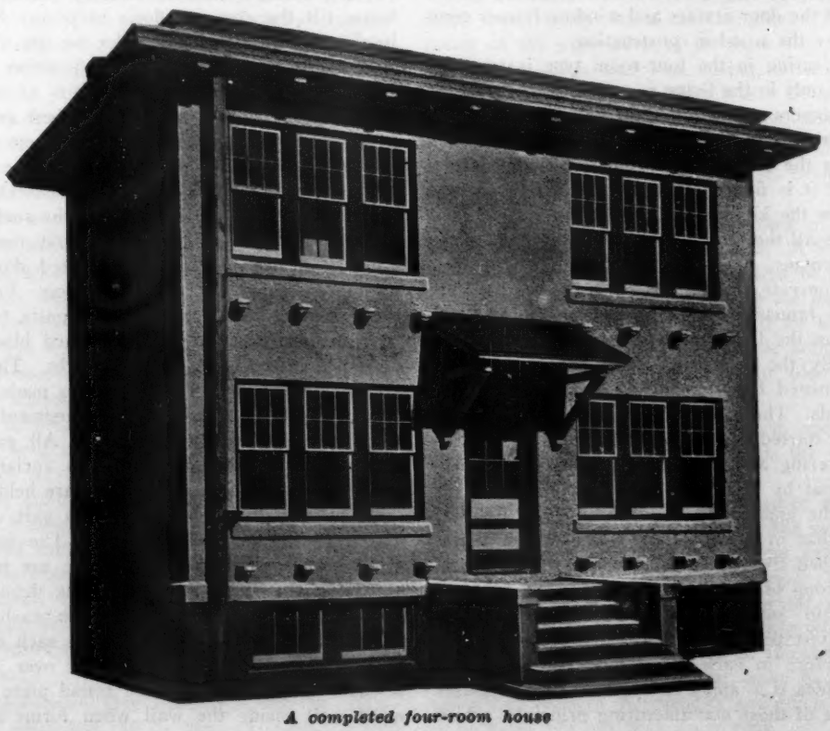
On entering the four-room house one hardly expects to find room for a modern bathroom, but it is there just the same, and a surprisingly good bathroom at that. Each of the bedrooms has a closet, and the kitchen cabinet built in the combination kitchen and dining-room is one that would look all right in a house costing $6,000 or $7,000 or more. Other good features are the laundry tub and kitchen sink placed together in such a way that the top of the tub serves as a drain board for the sink. All of these details have been worked out so as to give the largest amount of conveniences in the room available.

Cinder concrete is used in the Phillipsburg work, and the four-room houses require 80 cubic yards each. The amount of reinforcing is 1,600 pounds per house. The roof, walls, partitions and under floors are poured in one operation. Window frames, door frames, flue linings, electric light conduits and plumbing roughing are all placed before the concrete is poured. It is possible by the same system to pour the front and rear steps and cellarway while the remainder of the house is being poured. The arrangement of front and rear steps is the same in the four-room house, thus permitting the same forms to be used. The six room house has a distinctive rear porch as will be seen by the accompanying view.

The cellar walls are eight inches thick and it will be observed that the cellar is well out of ground and is unusually well lighted, thus giving desirable additional space in the basement floor.

In a number of cases, in these Phillipsburg houses, where the ground slopes back from the house, an artistic back entrance through the basement door is provided for rather than a flight of steps to the first floor.

Walls above the first floor are 6-in. solid concrete but have grounds on which furring can be nailed. An interior thin wall is then placed, consisting of Bishopric Board and plaster, which gives a 1-in. air space between the main wall and the plaster wall. This plaster wall has a sand finish. The beamed ceiling is in white plaster. The outside of the house is first washed down with a stucco coat in which a proportion of hydrated lime is used so as to fill up pores, and provide a white background on which a slap of stucco finish can then be applied. This slap finish is put on with a rough brush. By varying the color of the outside finish—white, buff,



A completed four-room house

A completed six-room house

salmon, etc., a pleasing variety is obtained.

The pouring operation can be completed in eight hours. In the Phillipsburg development the forms have been removed from one house beginning Monday at noon, taken across the street to another site, forms completely erected, house poured and concrete work entirely done by Saturday. During December the houses were kept heated for four days as a protection against freezing or a retarded setting of the concrete. Straw packing is used as a protection for outside surfaces.

Both the upper and lower floors are concrete with wooden grounds on which a wood floor is nailed. The stairway from the first to the second floor is also of wood. These and the door frames and window frames comprise the wooden construction.

Heating in the four-room type is provided for only in the living room and kitchen, as the designers deemed it unnecessary to heat the bedrooms in so small a house. The bathroom gets the excess heat from the kitchen stove, and it is figured that the circulation of heat from the kitchen and the bathroom will provide all the heat that may be required for the bedrooms.

Concrete, Detroit, Mich., in its August, 1918, and January, 1919, numbers, has this to say about the Ingersoll type of concrete house:

"By the Ingersoll system no variation is permitted between houses cast in one set of molds. The basic idea with which Mr. Ingersoll started developing his system (whose engineering and building problems were worked out by Harvey Dodge, with many details of the application handled by Fred Fowler) is that of *manufacturing* houses as distinguished from their construction, producing in a group of houses a continuous repetition of certain sets of operations, permitting the greatest possible economy in erection of the structure in each individual case. In short, the idea is to apply in some measure to houses some of those manufacturing principles which have scored so successfully in making Ingersoll watches.

"The Ingersoll system is the nearest approach which has been made to the theory of house construction advanced eight or ten years ago by Thomas A. Edison. The outstanding difference is the fact that in the Ingersoll system no top form is used for the floors. The hydrostatic pressure of the concrete in the walls, the pouring being continuous for the complete structure, is disregarded. Advantage is taken of the fact that concrete of a proper consistency, allowed a few minutes in which to congeal, ceases to flow even under considerable pressure later applied. Pouring is first done on one side of the house till the concrete flows to proper floor level and then pouring is done on the other side, returning later to the first position.

"The wood forms are built out of 2-in. stock crossed at right angles with best grade ⅞-in. lumber, creosoted to preserve them and thoroughly painted. They are oiled before use and cleaned after use to such an extent as may be necessary and oiled where the surface requires it. The excavation is first made; 2 in. × 4 in. side rails are staked down; footings and floor placed in one piece. From this basement floor, vertical corner posts, 6 in. × 6 in., are first set up on wedged blocks, the posts extending to a story height. These are held plumb and true by trusses made of 4 × 4's and ⅞-in. bridging. Adjustment to true lines is virtually automatic. All parts are carefully made and permit no variation greater than 1/16 in. The trusses are held to posts by iron bands made on each part and driven rigidly home by wedges. The form members proper, inside and outside, are supported by trusses with bolts passing through from outside to inside with wooden washers for spacers, these being covered at each end by round iron washers strung on over the wooden washers to leave the round piece of wood well inside the wall when forms are removed. Outside forms are held further to line by horizontal 4 in. × 4 in. stringers. The floor forms inside are also supported by the trusses, as is also the entire weight of the false structure and of the concrete as placed. Trusses carry the load to the 6 in. × 6 in. posts, ten of which are used in each story. The outer forms support brackets for staging from which the upper forms are handled in erection and in stripping. The cornice and parapet forms are held by braces to outer forms, each piece having a precise location. In fact, every piece used has its unit number and a definite place in the erection scheme. Even with common labor, after a few operations, it has been possible to take a piece down from one house which has been poured and set it in the proper position on the next house without rehandling. (At Phillipsburg a runway between two houses made this shifting very rapid). When a certain stage of erection is reached the plumber and electrician are sent for and the conduits and pipes which are prefabricated are set in the walls with few lost motions. Reinforcing rods and metal flue linings are then placed and nailing blocks are set. Concrete flue lining will probably take the place of the metal flue lining now used. Blocks are placed ready to hand for embedding in floors when they are screeded. The concrete used is one part cement, two parts sand, and four parts cinders. The steel used is as follows: In each corner of building ½-in. rods; a ½-in. rod each side of each opening; ⅝-in. rod extending entirely around the building at each floor level with extra steel at door and window lintels.

In the erection of the forms the entire weight of the structure, both forms and concrete, is first placed on the corner posts, which in the four-room house are ten in number. Yet these corner posts are first to come down when the forms are stripped. This is possible in view of the fact that the bolts passing through the walls and trusses, which support the forms, serve as a means of transferring the load to the concrete. As soon as a house is from 24 to 48 hours old under favorable weather conditions, the wedges are driven out, the corner posts are removed and set up for the next house in the operation. Trusses are then taken down and if the floors require further support temporary shoring of about two 4 × 4's in each room are put in. The trusses are then removed and set up on the corner posts for the next operation. The form parts then come down in pieces as needed on the next job. The floor forms, which are usually the last to come down, are the last to be required to be set up on the next operation."

The houses, instead of being laid out monotonously side by side, are in some cases grouped so as to form a large yard or court.

Mr. F. M. Coogan, an executive of the Alpha Portland Cement Company, is president of the Phillipsburg Development Corporation and the construction work is under the direction of Mr. Paul R. Smith, an experienced architect.

Unwatering the Tiro General Mine by Air-lift

Results of Exhaustive Tests on the Performance of Four Air Lift Systems. Detail of Equipment—Submergence and Efficiency Factors*

By S. F. SHAW, E. M.
Supt. American Smelting & Refining Co.*

IN 1913, the Tiro General mine, at Charcas, S.L.P., Mexico, which had been making from 125 to 150 gal. of water per min., was allowed to become flooded, after all the pumps had been removed, and in 1918 the problem of unwatering it came up for solution. There are two vertical shafts, the Tiro General, 1390 ft., and the San Fernando, 1225 ft. in depth, with five connecting levels between them. Soundings indicated that compartments in the Tiro General were open to 1082 and 428 ft., and in the San Fernando shaft to 471, 488, and 586 ft. The water had risen to a point 140 ft. below the collar of the Tiro General shaft.

The steam plant at the Tiro General shaft includes one 300-hp., one 150-hp. and one 100-hp. Erie City water-tube boiler and two 160-hp. Heine water-tube boilers. The compressed-air plant comprises one Nordberg cross-compound compressor with piston displacement of approximately 2500 cu. ft. of free air compressed to 96 lb. per sq. in.; and another Nordberg cross-compound with piston displacement of 1235 cu. ft. of free air, to the same pressure.

The main pump station is on the seventh level where had been installed a Prescott pot-valve plunger pump with capacity of 200 gal. per min.; also a Gould triplex plunger pump with capacity of 135 gal. per min., driven by a 6½ by 10 by 12 in. steam engine. From the lower levels the water had been raised to the seventh level by small station pumps and sinking pumps.

Although the submergence of an air-lift pump at the final stage of unwatering to the seventh level would be limited to about 225 ft., we were assured by pump manufacturers that this point could be reached by a single-stage air lift, and we therefore decided to adopt this method. The equipment to be purchased consisted only of piping, footpieces, etc., since the compressor plant was considered adequate for the purpose. Not only did we save the first cost of such equipment as sinkers, or centrifugal pumps and motors, but we also found that delivery of pipe could be effected in much less time than pumps and motors.

At the beginning of operations, two air-lifts were installed, one in the Tiro General and one in the San Fernando shaft. These were operated until it became evident that they were not suitable for the work to be required of them at greater depth; they were then removed and replaced by air-lifts of better design, designated Nos. 3 and 4. Since the lift involved in lowering the water to the seventh level, where steam pumps could be installed, was much greater than had ever been attempted before where a large quantity of water was to be handled, it was necessary to make many careful experiments as the work progressed, in order to anticipate the probable performance of the lifts that were installed. In order to show the line of development, the successive installations will be described.

*Abstract of paper presented before the American Institute Mining and Metallurgical Engineers.

Air-Lift No. 1

Delivery Pipe.—The completed line consisted of 600 ft. of 6-in. spiral-riveted pipe, from the footpiece, a 6 to 5-in. reducer, 23 in. long, 100 ft. of 5-in. spiral-riveted pipe, a 6-in. nipple 7 ft. 9 in. long attached to the headpiece, to permit rapid connection of the spiral pipe, a 6-in. nipple 26 in. long within the headpiece, and at the footpiece a 6-in. nipple 4 ft. 1 in. long which allowed the riveted pipe to be conveniently connected with the footpiece. The total length of the delivery line was therefore 716 feet.

Air Line.—The air line from the footpiece to the shaft collar consisted of 4¼-in. casing; this was connected flexibly to the 6-in. air main from the compressor plant.

Footpiece.—A Talbot 6-in. footpiece was used. The body, being of wood, was wrapped in sheet iron and wire to protect it from falling rocks.

Headpiece.—This was a sheet-iron tank, 36-in. in diameter, and 69 in. high inside measurements. In the center of the bottom was a 6-in. hole, to which both above and below, flanges were bolted into which 6-in. nipples were screwed. The inside nipple was 26 in. long while the lower one was 7 ft. 9 in. long, and had a flange screwed on its lower end, by which connection could be made easily and quickly with the 6-in. spiral-riveted pipe. A 12-in. opening was cut in the side of the headpiece, close to the bottom, from which the water was conducted through a 12-in. pipe to the measuring box.

Carrier.—The lower 300 ft. of the water column and air pipe were suspended below a carrier, the frame of a 4-ton skip from which the box had been removed. The pipes were supported on the floor of the carrier by heavy iron clamps which also carried the weight of the columns above the carrier. The carrier was hung from a sheave wheel to the axle of which were attached shoes which fitted the shaft guides. A 1-in. steel-wire cable from the hoisting engine and headframe sheave passed under the carrier sheave, and then up to the headframe, where its end was securely attached. This arrangement diminished the danger of breaking the cable and permitted the entire weight to be raised by the hoisting engine.

Operation.—This equipment was in operation from Feb. 10 to May 19, during which time the lift ranged from 155 to 485 ft. and the capacity decreased from 525 to 270 gal. per min. As the lift increased, the capacity of the 6-in. water line constantly diminished. A series of tests was made to find the relation between lift, amount of water raised, and cubic feet of free air consumed. A fairly constant decrease in pumping capacity, for a given diameter of water column, as the lift increases was noticed, provided the depth of submergence remained constant.

It was observed that beyond a certain amount of air, further additions did not increase the quantity of water raised; this point is designated as the "maximum capacity." Another point was observed on all curves at which the pumping efficiency was greater than for either a smaller or larger amount of water; this is designated as the point of "maximum efficiency." The capacity at which the air-lift was operated during any day is designated the "operating capacity."

Air-Lift No. 2

Delivery Pipe.—The water column ultimately consisted of 865 ft. of wood pipe, of 6-in. diameter at the footpiece and 6⅜ in. at the top. This was tightly bound by wire to the air pipe from the footpiece to the carrier, a distance of 300 ft., in such manner that its entire weight was carried by the air pipe. The joints were wrapped with light canvas, painted with heavy fuel oil and wrapped with No. 16 annealed iron wire, in spite of which there were many leaks in the line. The staves of the pipe were ½ in. thick.

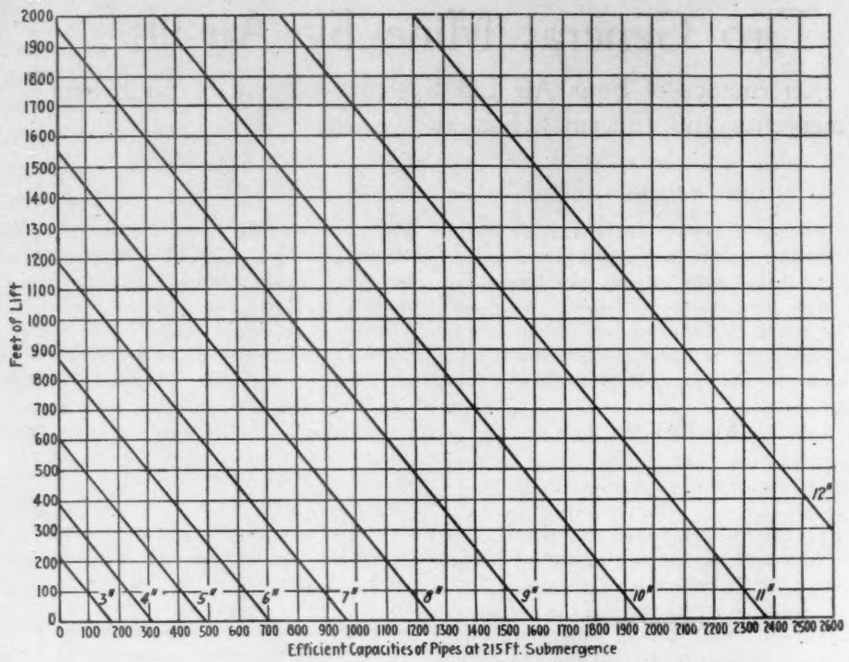
Air Pipe.—This was 3-in. casing, from the footpiece to the shaft collar, where it was attached through flexible connections to the 6-in. air main.

Footpiece.—This was a Talbot 6-in. design, like the one used on No. 1 lift.

Headpiece.—This was a wooden tank of 42 in. inside diameter and 36 in. depth. A 9-in. flanged nipple 22 in. long was bolted to the bottom on the inside, through which the wood pipe passed. A deflector was held by long bolts at a distance of 32 in. above the bottom. The water escaped through an 8-in. pipe to the measuring box.

Operation.—This installation was in operation between May 17 and July 23, the lift ranging from 465 to 657 feet.

The slightly larger diameter, together with the reduced friction on the sides of the wood pipe, increases the capacity to some extent over that of the 6-in. spiral-riveted pipe. The consumption of air per gallon of water was also diminished as compared with that which would have obtained with the 6-in. spiral-riveted pipe. There were several leaks in the pipe which reduced the capacity and efficiency by probably not less than 5 per cent.



Most efficient capacities of pipes of various diameters at constant submergence of 215 feet

Air-Lift No. 3

Delivery Pipe.—The delivery line ultimately consisted of 1050 ft. of wood pipe of 8¼ in. diameter at the footpiece, increasing gradually to the discharge, where it was 12½ in. diameter. The staves were 1 in. thick and the joints 2½ in. long. The outside of each joint was first coated with tar, then wrapped with about 10 ft. of canvas, 5 in. wide, and then close wrapped with No. 16 annealed iron wire, covering the entire canvas. At the beginning, the length of pipe was 765 ft. and required 5½ days for installation.

Air Pipe.—This consisted of two parallel lines, 400 ft. long, of 3-in. and 4¼-in. casing, extending from the footpiece to the carrier; above this point these pipes were connected to a 6-in. spiral-riveted pipe, 520 ft. long, and then reduced to 5-in. spiral-riveted pipe which reached to the collar of the shaft, a further distance of 100 ft.

Footpiece.—The footpiece was made at Charcas, and consisted of an inner casing pipe, 8-in. diameter, in which were bored four rows of 14 holes each, the diameter of the holes being 9/16 in. Air was introduced into the footpiece by suitable connections through a 10-in. extra-heavy pipe fitted outside the 8-in. pipe. A Talbot 8-in. footpiece collapsed at the beginning of operations.

Headpiece.—This was practically identical with the one used for No. 2 lift.

Operation.—This installation operated from Aug. 19 until Oct. 6, with lifts ranging from 548 to 843 ft., and capacities of from 900 gal. at 548 ft. to 443 gal. at 843 ft. A test was made at the beginning, before one of the compressors broke down, allowing sufficient air to enter the footpiece to produce a continuous flow. During this test the lift was 548 ft., submergence 230 ft., air 3325 cu. ft. per min. (altitude of 7250 ft.), and flow of water 1100 gal. per minute. After one of the compressors broke down, there was insufficient air to produce a continuous discharge, and the lift operated in pulsations of 50 to 60 sec.

Owing to the irregular operation, it was impossible to obtain close measurements of the flow of water, and therefore tests were not made as for the previous installation. Moreover, there was insufficient air to carry the tests to a proper conclusion. The second compressor was repaired and placed in operation when the lift reached 774 ft., thus accounting for the increased discharge at that point.

Air Lift No. 4

Delivery Pipe.—The completed line consisted of 270 ft. each of 7-in., 8-in., 9-in. and 10-in. spiral-riveted pipe, with appropriate reducers, each 23½ in. long. Inside the headpiece was a 10-in. nipple, 26 in. long, making the total length of the delivery line 1090 ft. Installing the pipeline, with an original length of 1030 ft., required 2 days.

Air Line.—This consisted of parallel 3-in. and 4¼-in. casing from the footpiece to the carrier, 365 ft. and 500 ft. of 6-in. spiral-riveted pipe above the carrier, followed by 200 ft. of 5-in. spiral-riveted pipe to the shaft collar.

Footpiece.—The footpiece was of the same design as used with the No. 3 installation. The headpipe, also, was practically identical with that used for No. 2 installation.

Operation.—This air-lift was in operation from Oct. 10 to Jan. 6, the lift ranging from 812 to 1072 ft., and the operating capacity from 465 gal. at the former to 65 gal. per min. at the latter distance. The submergence was only 18 ft. A steady flow was obtained from the first and continued throughout.

Table 8 shows the operating capacity of this air-lift at intervals of approximately 10 ft. Since it was operated close to the point where pulsations would begin, it is probable that the operating capacity was close to the efficient capacity.

San Fernando Air-Lift

Delivery Pipe.—The water delivery pipe consisted ultimately of a 6-in. nipple 3 ft. long at the footpiece, a reducer, 6 to 5-in., 23 in. long, 560 ft. of 5-in. spiral-riveted pipe, a 5-in. nipple 14 in. long below the headpiece, and a 5-in. nipple 24 in. long inside the headpiece, making a total length of 568 ft.

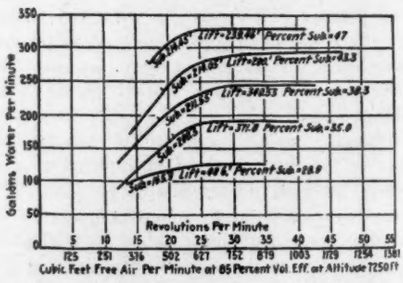
Air Pipe.—This was 3-in. standard pipe, connected through flexible joints to a 3-in. line 1500 ft. in length.

Footpiece.—The footpiece was an Ingersoll-Rand 6-in. "Imperial," with air admission for a 1½-in. pipe. It was 7 ft. long, the inside pipe being 6½-in. diameter to the throat, where it was 6-in. diameter; the outside pipe was 8⅝-in. diameter.

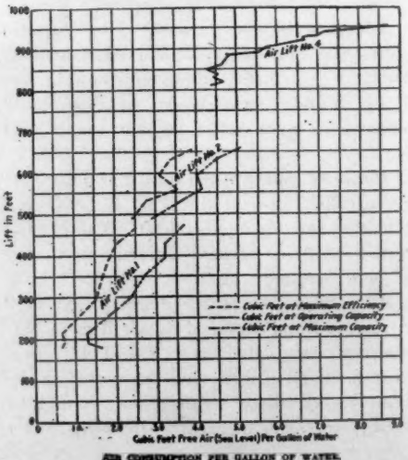
The headpiece and the carrier were similar to those used with Tiro General No. 1.

Measuring Box.—This was a steel tank 8 ft. 6 in. long, 3 ft. 2 in. wide, and 3 ft. 8 in. deep, provided with a 90° V-notch weir and with baffles to insure a quiet overflow. Below the discharge, a cylindrical tank 31-in. diameter and 8 ft. 6 in. long was placed in order to check the weir measurements. A Sanborn automatic recording water gage was connected with the measuring box and continuous records were kept.

Operation.—This air-lift was in operation from March 19 to May 9, during which period the lift ranged from 205 to 438 ft., and operating capacity decreased from 300 to 70 gal. per min. With a lift of 439 ft. and submergence of 134 ft. this air-lift would operate only in pulsations, and it was therefore taken



Consumption of free air per minute


Lift in Feet
Air Lift No. 4
Air Lift No. 3
Air Lift No. 2
Cubic Feet at Maximum Efficiency
Cubic Feet at Operating Capacity
Cubic Feet at Maximum Capacity
Cubic Feet Free Air (Sea Level) Per Gallon of Water
AIR CONSUMPTION PER GALLON OF WATER

Consumption of free air per gallon of water

out of commission. The submergence could not be increased, owing to an obstruction in the shaft.

In practice it was found that if an excessive amount of air were admitted to the footpiece, a large proportion would escape below the bottom of the footpiece, due to the fact that the air-admission holes were too small and too few in number.

Capacity of Delivery Pipe

Our work at the Tiro General Mine has led toward certain tentative conclusions as regards the capacity of water delivery pipes used in air-lifts. The capacity of pipes will vary with four factors. The diameter (or area) of the pipe; the submergence; the lift; and the quantity of air admitted to the footpiece.

Diameter.—The capacities of water columns at zero lift and given submergence vary directly as the area of the pipe. As the lift increases, the difference in capacities between pipes of different diameters remains constant. From our experiments it would appear that the most efficient capacity of a pipe with submergence of 215 ft. is approximately 25 gal. per sq. in. of area per min. The chart gives graphically the most efficient capacity of pipes of various diameters, assuming a constant submergence of 215 feet.

Since the No. 3 and No. 4 air-lifts used water columns of varying diameter, it was not possible to make closer comparisons of these with the 5-in., 6-in. and 6⅜-in. air-lifts. However, rough comparisons appear to indicate that the capacity of a water column of varying diameter is equal approximately to the capacity of a pipe having an area of 85 per cent. of the average area of the varying column.

Submergence.—The capacity of a pipe of given diameter, at constant lift, will vary with the submergence, within certain limits. Experiments tended to indicate that if equal lengths be added to the submergence and to the lift, the capacity would remain practically constant; however, the range covered by these observations was too limited to draw any positive conclusions.

Lift.—With a water column of given diameter and submergence, it is seen that the capacity, whether it be the efficient capacity, operating capacity, or maximum capacity, varies inversely with the lift.

Quantity of Air.—The quantity of air admitted to the footpiece affects the capacity of a water column of given diameter, lift, and submergence; within certain limits there is a point where no discharge of water will result. If the air is further increased, the quantity of water will increase until a limit is reached, beyond which no increase in water will result, however great the quantity of air; this we have termed the point of maximum capacity.

Experiment was made with No. 3 air-lift, at a time when the lift was 840 ft. and the submergence 192 ft., by admitting air up to 1250 cu. ft. of free air per min., up to which point there was no flow of water. This lift continued to operate in pulsations, and it was impossible to secure a steady flow with the greatest quantity of air admitted, that is, up to 3,000 cu. ft. per minute.

A similar experiment was made with No. 4, having submergence of 200 ft. and lift of 840 ft.; no flow of water resulted with air up to 950 cu. ft. free air. Beyond that point, the water issued in pulsations until 2700 cu. ft. of air were admitted, when it became steady.

It would be impracticable to keep compressors operating at all times at such speed as to maintain a flow of water at the exact point of maximum efficiency, especially where the lift and submergence are constantly changing, as in unwatering a mine. Moreover, the rapid lowering of the water level is usually of more importance than decreased efficiency. However, if the installation is well designed, it is probable that the capacity can be maintained within a reasonable distance of the most efficient capacity.

Quantity of Air Consumed

It will be seen that the quantity of free air consumed per gallon of water raised is considerably greater during daily operation than when pumping at highest efficiency, as shown in the various tests. It was desired to unwater the mine as quickly as possible; hence Nos. 1 and 2 and the San Fernando air-lift were run at a capacity greater than the efficient capacity of the water delivery line.

Conditions vary so widely between lifts of 140 and 900 ft. that it would be difficult to design an air-lift that would operate at highest efficiency at all stages of the lift. However, for the conditions of lift noted, where the capacity of the compressors was limited to 3,000 cu. ft. of free air, No. 4 air-lift was probably as nearly the most efficient design as could be secured. The chart shows the relations between the lift and the quantity of free air required per gallon of water for air-lifts Nos. 1, 2 and 4.

Efficiency

Our work has led us to adopt the following generalizations:

1. The pumping efficiency of a given installation may decrease somewhat as the lift increases while submergence remains constant, but should not decrease very greatly.

2. If the submergence is decreased, the pumping efficiency will decrease.

3. The pumping efficiency is somewhat higher in pipes of large diameter than in those of small diameter and is probably some-

Daily Air-lift Data

Date, 1919	Level Below Collar	Lowered, Feet	Total Gallons	Cubic Feet Air per Gallon	Hours Operation	Number Revolutions	Fuel Oil, Gallons	Average Air Pressure	Average Steam Pressure	Lift, Feet	Submergence, Feet	Gallons per Minute	Per Cent. Submergence	Pump Efficiency
Feb. 10	146.0	1.7	328,500	2.58	18¼	43,800	1,730	87	99	154.4	192.3	300	55.5	
15	149.13	0.30	224,000	1.43	13½	16,130	2,205	80	95	157.5	189.7	280	54.6	
Mar. 1	168.36	2.93	626,400	0.98	24	31,208	1,700	81	102	181.6	190.4	435	51.2	
8	185.13	1.94	598,000	0.84	21⅝	25,773	2,565	82	94	198.4	191 7	460	49.1	
15	198.52	1.80	705,600	1.05	24	37,469	1,615	75	97	211.8	178.4	490	45.7	
Apr. 1	263.52	2.53	832,160	1.16	18⅜	48,869	3,078	91½	95	269.0	215.5	743	44.5	
12	328.00	7.12	921,600	1.63	24	75,900	3,420	96	98	335.0	224.5	640	40.2	
May 1	431.11	4.16	568,800	2.90	24	83,604	2,650	103	100	440.0	223.0	395	33.6	
15	451.15	2.23	416,100	2.93	23¾	61,794	3,591	104	92	468.43	246.43	292	34.5	
Jun. 1	515.86	4.76	489,600	2.90	24	71,660	2,000	98	98	537.00	213.00	340	28.4	37.0
15	544.78	0.95	340,200	3.06	21	52,638	3,847	108	96	568.0	213.0	270	27.3	36.6
Jul. 1	591.43	3.06	408,980	3.30	23⅝	68,408	2,050	108	102	613.4	228.3	286	27.1	35.5
15	622.75	2.03	381,600	3.85	24	74,387	1,537	110	102	645.2	228.3	265	25.9	
Operations discontinued July 24 to install 8¼ in. lift														
Aug. 19	526.45	3.65	573,000	1.08	9½	48,031	1,539	98	120	548.3	229.9	900	29.5	
Sept. 1	638.13	1.47	882,000	2.01	21	89,900	2,632	106	117	659.14	253.06	700	27.7	
15	698.48	3.80	598,500	2.90	21	87,760	1,881	108	120	718.3	253.4	475	26.1	
Oct. 1	785.82	7.08	769,950	3.41	21¾	130,348	2,760	97	118	804.0	219.9	590	21.5	
7	Operations suspended 7.30 A. M. Oct. 6 to change No. 3 to No. 4 air-lift													
15	836.26	5.77	597,600	4.38	24	131,806	3,078	102	123	852.9	237.3	415	21.7	37.2
Nov. 1	921.47	0.74	337,005	7.42	19	124,465	2,736	71	122	940.7	149.6	292	13.7	29.8
15	940.92	1.21	309,600	9.38	24	143,996	3,591	63	124	958.9	131.4	215	12.0	
Dec. 21	1012.80	0.00	151,840	18.8	23⅝	143,894	4,160	—		1030.94	59.3	—	5.4	—
Jan. 1	1039.29	5.64	115,020	21.00	20¼	120,750	6,276	22	114	1058.26	32.0	102	2.7	
5	1048.23	7.50	96,480	29.68	24	142,145	6,763	27	120	1070.02	20.00	67	1.9	

what higher in pipes expanding upwards.

In order to ascertain the point of maximum efficiency, tests were made beginning with admission of air just sufficient to start the water flowing, then enlarging this amount gradually until no further increase in flow of water could be obtained. Curves of these tests were then plotted. If a straight line is drawn through the origin of coordinates, tangent to the curve, the point of maximum eficiency for the set of conditions involved in this curve will be located. It has been our experience that at this point the gage pressure, allowing for friction in the air line, is practically that necessary to balance the submergence.

If the water level is gradually lowered while the depth of submergence remains practically constant, a periodical plotting of these curves will reveal the fact that the quantity of water that can be raised, whether at maximum efficient capacity, operating capacity, or maximum capacity, gradually diminishes. It is therefore important, in designing a lift for unwatering a mine, to make the pipe line of sufficient size to handle the desired quantity of water when approaching the final stage of unwatering.

The efficiencies attained in air-lift pumping are not so high as those reached by centrifugal pumps, especially when the latter pumps are in good condition and working under proper head and at proper capacity; nevertheless we believe that the over-all efficiency of an air-lift will, in many cases, be found approximately equal to that of any form of pumping apparatus. Labor costs are reduced to a minimum; with the air-lift once properly installed, no labor is required except the engineer in the compressor plant. One very great advantage over all other forms of pumping apparatus is that the air-lift is in no danger of being drowned by a suddenly increased flow of water.

As air-lift pumping becomes better understood, it is quite likely that installations will be made in which 18 to 24-in. boreholes will be sunk at suitable points along the workings, with such depth as to provide submergence that will result in the highest working efficiency. Connections with all the levels in which there is a flow of water would then enable the air-lift to do the whole pumping from the mine. By locating such a hole close to where a shaft is being sunk in wet ground, the cost of shaft-sinking can be much reduced. The air-lift will show a much higher efficiency than a pump driven by compressed air; it is often found that considerable pumping is done, in mines, by compressed air where it is not practicable to carry steam lines.

In case of such a permanent installation, a bore hole could be driven which would suffice for all future requirements. One of 24-in. diameter to a depth of 1500 ft. would probably suffice to admit pipe sufficient to discharge up to 2,000 gal. per min. with a lift of 1,000 to 1200 ft. In making such an installation, in order to be certain of having a proper balance to insure the highest efficiency, careful study should be made to determine the proper compressor capacity, proper sizes of air and water pipes, and correct design of the water pipe. If the water is heavily charged with acid, the water pipe should be of wood wrapped with copper wire, and the air pipe should be of wood, copper or brass.

Operating Data at Tiro General Mine

The Table of Daily Air Lift Data gives the principal data that were summed up daily, covering the operation of the air-lifts at the Tiro General mine.

The first column gives the data covered by the set of observations. The second gives the water level in the shaft at 7 A. M. The third notes the distance that the water was lowered in the shaft; in a few instances the water arose above the point reached on the previous day, in which case the minus sign is used. The fourth column gives the total gallons pumped during the 24 hr. The fifth gives the cubic feet of air consumed (sea-level basis) per gallon of water raised; the volumetric efficiency of the compressors was assumed at 85 per cent., and the resulting volume was divided by 1.27 to reduce the volume from 7250-ft. altitude to sea-level basis. The seventh column gives the combined number of revolutions of the two compressors. The eighth gives the gallons of fuel oil consumed during the 24 hr., but this whole quantity was not used for pumping; hoists, shop machinery, etc. were driven by steam from the same boilers. The ninth column gives the average air-pressure at the compressor, and the tenth gives the average steam pressure for the 24 hr. The eleventh column gives the average feet of lift, and the twelfth the average feet of submergence for the 24 hr. Average number of gallons for the 24 hr. is given in column 13; average percentage of submergence in column 14; and pumping efficiency in column 15.

Air-lift No. 1 was in operation alone between Feb. 10 and Feb. 28. Between Feb. 28 and May 9, the data refer to the Tiro General No. 1 and the San Fernando air-lifts combined. From May 19 to July 23, No. 2 air-lift was operating alone; from Aug. 19 to Oct. 6, No. 3 alone; and from Oct. 9 to Jan. 6, No. 4 alone.

HINTS TO METAL WORKERS ON HANDLING ROLLED ZINC

The New Jersey Zinc Company has issued a little folder entitled *Hints on Forming Zinc*, that it is sending out free to persons or firms that indicate a desire for taking advantage of available information along this line. Besides some figures showing the difference in three varying guages of zinc, the folder offers seven distinct essential points for metal workers who are called upon to handle rolled zinc. Presumably the following suggestions are the result of the New Jersey company's own experience:

1. The depth of the first cup should not be more than 45 to 50 per cent of its diameter. Subsequent steps may be about the same as in brass.

2. The best results will be obtained by starting with a blank of approximately the same guage as the desired ultimate wall thickness.

3. Use as little tension as possible on the pressure pad, only enough to keep the blank from wrinkling.

4. Give the dies as much radius as possible. This will reduce breakage to a minimum and will also reduce wear on the tools.

5. Annealing and pickling operations are unnecessary and, in fact harmful to zinc.

6. Soap appears to be the most satisfactory lubricant.

7. In extremely cold weather it is advisable to warm the zinc slightly, preferably in a bath of water heated to not more than 125 degrees Fahrenheit.

ODOR SPREADS ALARM IN MINE'S FIRE DRILL

The miner who is unable to smell banana oil or garlic may be refused work in the underground mine of the future. For the Federal Bureau of Mines, according to a recent issue of *Popular Mechanics* after years of experiment, has found that these odors, not electric bells or lights, are the best possible means for spreading an alarm, and bringing men to the surface. In a recent test in a Montana mine, employing hundreds of men in miles of drifts and tunnels, the new alarm system worked so perfectly that every man was out in 15 minutes. Spreading the odor was easy, thanks to the compressed-air system, installed, incidentally, in every large mine to operate drills, and ventilate headings. The oil was stored in a container at the compressing station. At a signal from the superintendent, the watchman turned a valve, the volatile oil was sucked into the main pipe, and in an instant had reached every nose in the mine. Even more effective than banana oil, would have been a horribly repulsive chemical of concentrated garlic odor.

WOULD ESTABLISH TRADE CHAMBER IN BRAZIL

A movement to organize a New York branch of the American Chamber of Commerce for Brazil, which now operates in Rio de Janeiro and Sao Paulo, was launched at a luncheon held at the Bankers' Club. Leslie E. Freeman, representative here of the chamber, arranged the meeting.

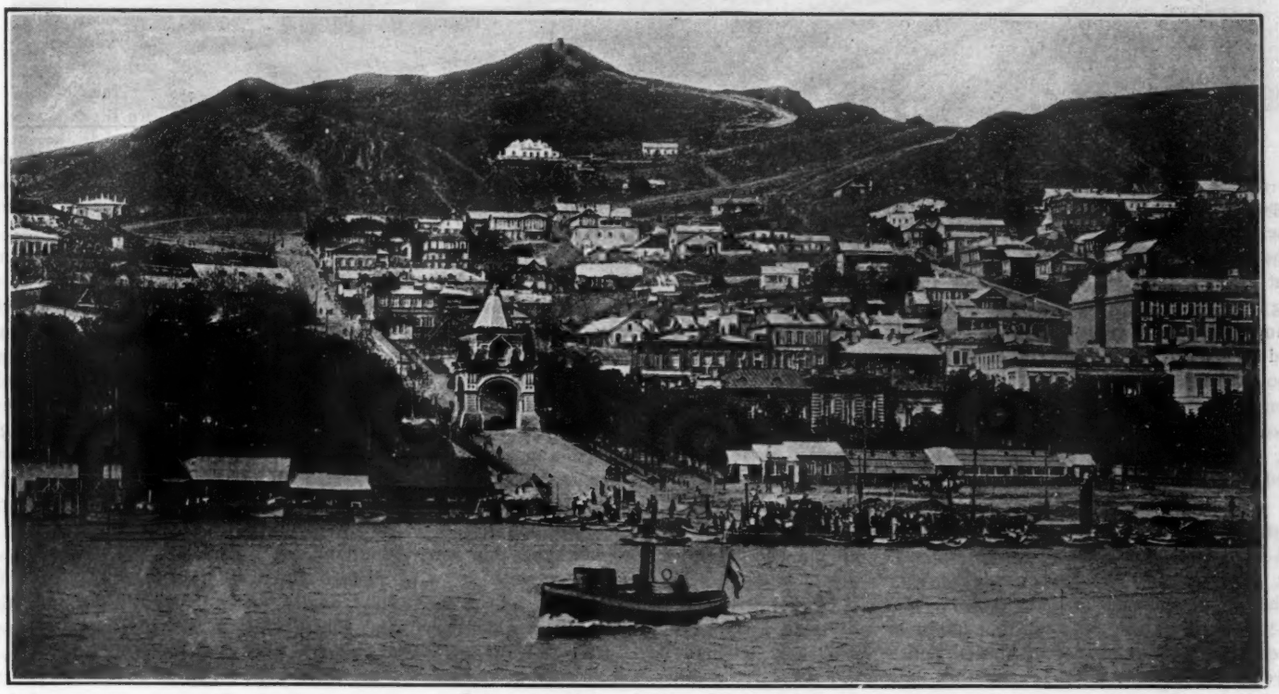
Mr. Freeman was authorized, by a motion passed by those present, to name a committee of five to prepare a plan for the establishment of the proposed branch. This committee will report at a meeting subsequently to be held. Mr. Freeman said he would be glad to answer inquiries sent to him to 37 Liberty Street, New York.

Those present at the meeting included Edwin V. Morgan, the United States Ambassador to Brazil; John L. Merrill, president of the All American Cable Company; Dr. Garcia Leno, consul general of Brazil; Julius Lay; William P. Hamilton; T. B. McGovern, Jr., Frank Garcia and O. K. Davis, secretary of the National Council of Foreign Trade.

An American Engineer's Experience In Russia

Incidents Connected with the Construction of a Railway Car Assembling Plant—Influence of Church and Class and the Character of Russian Executives and Workmen—Early Days of the Revolution

By PARIS HIATT



Naval harbor, landing and keys at port of Vladivostok

THIS ARTICLE is written in narrative form following the travels of Mr. Hiatt during his stay in Russia, with observations as he goes along. It is educational as well as interesting, for it gives a good general idea of the country and the people, as well as a description of one of the largest engineering projects of the war.

UNTIL THE EUROPEAN WAR broke out, in the beginning of August, 1914, the average person in the United States and Western Europe knew very little about Russia and the conditions of living, traveling, etc., existing there. True, there had been a number of books and magazine articles written, and these found their way back into the United States and Western Europe and were read by very few people because the average person did not care much about Russia. The majority of people who did read these books and magazine articles were business men and tourists who had become tired of the usual tourists' routes and wanted to see something different and more exciting. In most cases the publications were written by people who had no knowledge whatever of the Russian language, and their authors based opinions on what they saw during short stays in a few of the larger cities, what they saw from car windows, and what others told them. It goes without saying that the various views produced were as different from each other as the four points of the compass. This left the reader as much in the dark after reading these articles as he was before.

After the commencement of the European War, people began to thirst for knowledge about Russia because it was evident from the beginning that Russia was destined to be a leading factor in the final outcome of the war, and also in the regeneration of the world after the war.

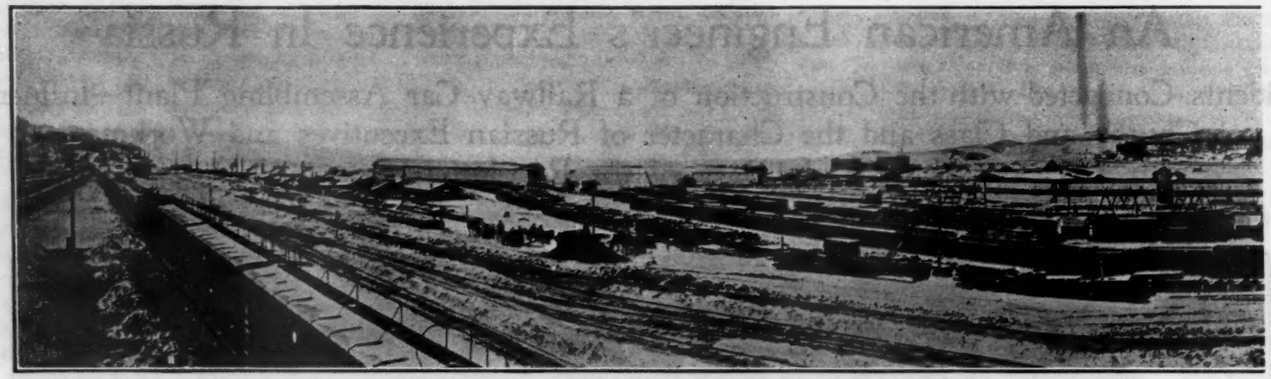
Today, the problem in Russia is one of vital importance to every person in the entire world, because Russia has fallen into the hands of the most unscrupulous despots, murderers, and thieves the world has ever seen. These people, following mad ideals and theories, are bent on destroying civilization and all that it stands for, not only in their own country, but all over the civilized world.

To satisfy this thirst for knowledge of conditions in Russia, volumes have been written in the last six years by everybody from ambassadors to Bolshevists, each expressing different and varying opinions, so that, after reading them all, one is left in a maze of misunderstanding that it is impossible to fathom. The reason for this is that one does not know what to believe.

The object of this article is not to theorize on how to overcome the present chaotic conditions in Russia, because too much theory and idealism, without firm action, have been expended on that subject already, but to give some facts about Russia and Russian people as a whole.

I went to Russia in the early summer of 1913 and stayed until late fall, 1917, when I was compelled to leave on account of the chaotic conditions and the utter inability to carry on business. My object was to stay there indefinitely, and I realized that to do business successfully it was necessary to learn the language as quickly as possible, know the people, their mode of living, temperament and business methods. Therefore, my entire stay was carried on in study, not only through books, but by mingling and talking to everyone with whom I came in contact, making no distinction of class.

I left London for Petrograd, (then St. Petersburg), on a Friday evening, traveling through Holland and Germany, and arriving at Werbollen, the Russian frontier town, at about one o'clock on Sunday. Here it was necessary to change from the German train into the Russian train, which runs on a broader gage track, also the usual frontier formality of customs inspection of baggage and the stamping of passports by the Russian police, as it has always been necessary to have a



A panorama view of the Russian railway car assembling plant at Vladivostok.

passport when traveling in Russia, even in peace times.

The next morning I arrived in Petrograd about nine A. M., and here a rather funny thing happened to me which is worth mentioning because it reveals that a foreigner could get along very well in Russia even without knowing the language.

For some reason or other I had misplaced the baggage check for my portmanteau, and on alighting from the train I motioned a *noseelstchik* (station porter) to where they were unloading the baggage. On seeing my portmanteau on the platform I managed by signs to make him pick it up and start out with it. We had not gone very far before a gendarme had us both in tow and it took me about an hour to explain in broken French to the chief of station police before I was permitted to go and this only after I had produced the magic and customary five rubles ($2.50) for a subordinate police officer and signed several documents, which I could not read.

Two things impressed me most in Petrograd, and later on in all my travels throughout Russia. These were Class and Church. Russia was a slave to both and one never could get away from either, even in the remotest parts of the empire.

As regards class,—certain uniforms were required to be worn by the school girls, school boys, and most everyone else. All technical persons wore uniforms with certain distinguishing marks on them, and of course, the peasant and workman were dressed in their usual leather boots and baggy clothes. It seemed to me as if the eternal stamp of class was labeled on each and every individual for his entire lifetime.

The church, which in Russia has some of the most famous edifices in the world, was perhaps the wealthiest single institution in the land. It was part of the government and the various churches were always open for worship and prayer. Each city and hamlet was generously supplied with churches, and even Ikons were placed on the streets. In every room of every building, be it home, hotel, or office, Ikons were hung in the corners, and I can truthfully say that I never saw a Russian, humble or otherwise, sit down to a meal without making the sign of the cross before and after the meal. It doesn't take much reasoning to understand that a nation that is as intensely religious as Russia is not given to murder, robbery, and the like by nature. Such acts are inspired and carried on by the few, and some of the few are forced to it by sheer want and necessity.

Petrograd at this time resembled very much the other modern capitals of Europe in every way save one, and that in respect to streets and method of conveyance. Due to bad streets, horse cabs were used almost entirely. Such horses! It was a real pleasure to ride behind them. Later on the good horses were taken to the front, and nothing remained but the broken-down ones, and this was pretty nearly true of the men as well.

After a brief stay in Petrograd I left on the Siberian passenger train for Western Siberia. This was a three days' run, and the train did not carry a diner, but stopped at stations for meals enroute. As I could not speak Russian, the conductor, for a small sum of money, gave me a slip of paper with a figure on it denoting the number of minutes the train stopped, just before we arrived at the station where food could be obtained. By consulting my watch I managed to grab something and eat it and get back on the train within the specified time. I soon learned, however, that in Russia they always ring one bell three minutes before the train starts, two bells one minute before it starts, and three bells and a whistle just as it starts with waving of green flags and an answering call from the locomotive.

Right here it is well to mention something about trains and train service in Russia as it used to be. (Heavens knows what it is like now!) Most all trains carried first, second and third class compartment coaches; some only carried second, third, and fourth. The express trains all carried one or more of the international sleeping cars and the only decent way one could travel was in the first class Russian cars, and first and second class international cars. Notwithstanding what has been written to the contrary, I want to say that the express trains running from Petrograd to Moscow, Sebastopol, and the South were as luxurious as any other trains in Europe, and ran just about as fast, while some of the trains off the main line were far slower than some of our accommodation trains. The railroads were mostly all government owned and the fares were absolutely cheap.

At the end of this three days' trip I made several journeys away from the railway with horses, these journeys consuming anywhere from one to eight days. One of them was to a large copper mine about 865 miles from a railway, and this took eight days' traveling, day and night. I changed horses every 25 or 30 miles, and did my sleeping in the Carabak, or Russian vehicle, in which I traveled. This was a sort of bath-tub body arrangement on four wheels without springs and was pulled by three horses, or, as the Russians say, a Troika.

These trips were almost unbearable at first, but I finally got so that I did not mind them, and subsequently I traveled many thousands of miles in this fashion.

On these trips I had an excellent opportunity to study the Russian peasant as I found him in his own home. He is a simple home-loving person, who would divide his last piece of bread with anyone whom he thought needed it. His main object in life is to live in his own little town, or on his own little farm, drink Vodka on holidays (which are all too many), and not be molested. The young Russian peasants and workmen certainly do enjoy their holidays, and they are as proficient in the art of eating sun-flower seeds as the young American is in eating peanuts or chewing gum.

I felt so secure among these people that I never carried any kind of weapon for self-protection, and I never needed one during my entire stay in Russia.

The freighting and hauling to out-of-town places in Siberia were mostly done with camels and oxen. The winter is the best time in most places for hauling heavy loads, because the roads are bad in summer, and in winter snow roads are used. The only disadvantage to this winter hauling is the fact that the animals have to be fed, and can't forage their living at night by the roadside.

After spending several months of this sort of traveling to various places in Siberia I made my temporary headquarters in Ekaterinburg, the place where the Czar and his family met their untimely death. This town is the metropolis for the Ural Mountains and Western Siberia, a country rich in coal, iron, copper, platinum, gold, lead, and zinc, besides

Production at this plant finally amounted to a maximum of 164 cars per day

being noted for so-called Ural stones, such as alexandrite, aqua-marine, amethyst, and many others. These mountains are also rich in marble and salt, the latter occurring in solution as well as in rock.

Most of the iron and coal mines were operated by the Russian Government, with not much modern machinery, and were all under the management of Russian engineers. The copper mines were usually part of huge estates which frequently covered several hundred square miles of territory. In addition, it is very natural that some of these estates were also rich in minerals above mentioned. These estates were owned, in most instances, wholly by Russians, and in some cases jointly by foreigners and Russians, since by law a certain share in all large enterprises must be owned by Russians. Further the law requires not less than 60 per cent. of the common labor to be native. Invariably where copper was found there would be an American or a Britisher on the job.

There were not many factories in this part of Russia, thus favoring the heavy importation of foreign goods, most of which were German. In fact, the domination of German products was general throughout Russia due to a very favorable trade treaty which they forced on Russia in 1905 when she was crippled by the Japanese war. About the only American machinery one saw in this part of Russia was farm implements, air compressors, rock drills, and core drills.

It was here in Ekaterinburg that I received my first Russian passport which was required after a continuous stay of six months in Russia. It is well to say a few words about passports here because it gives one a perfect understanding of how close a watch the Russian Government kept over their own people, as well as foreigners. One could never stay over night in a town or city without having his passport stamped by the police, and in the police office a perfect card system was kept with each person's name and any other data deemed necessary on an individual card. In this way a complete record was kept of everyone's travels and actions. These records, and many court records as well, were destroyed during the revolution. In fact, destruction was inspired to a great extent by liberated criminals for their own protection after the Revolution. As a result titles to many properties will never be rightly straightened out again.

My next move was to the industrial districts of Moscow and European Russia where I visited many different kinds of industries and found that in the textile trade, Britishers and British machinery predominated while in most of the other industries Germans were the dominating factors.

From Moscow I went to Kharkoff where I visited the coal mines of the Donetz Basin and the iron mines of the Krivol Rog district. In this region the greatest proportion of the steel was made in Russia, the coal and iron mines ranking with the finest in the world.

To the Southeast lies the great oil district of Baku on the shores of the Caspian Sea, and within easy access of the interior of Russia by the great water route up the Volga river.

I left here after a few months' stay and made numerous trips from one end of the country to the other, and on these trips I learned much of the Russian life and customs.

In the Spring of 1915 I went to Petrograd to look after the placing of some machinery in the Kronstadt and Reval fortresses and some of the large munition factories in Petrograd. During this time the war had broken out, the Russian armies had been defeated after spectacular advances into enemy territory and the Germans had taken the Baltic port of Libau and were advancing into Poland and Russia. Fiery speeches were being made in the Duma and prominent papers were hinting at pro-Germanism on the part of the cabinet ministers. Transportation was breaking down and the Russian people were beginning to see that the country had long been under the influence of Germany. They were asking why Petrograd had been made a manufacturing town when it was located 600 miles from the nearest coal and iron district; why had so much money been expended on the port of Libau and nothing done to develop Archangel and Kola Bay. The result was a feverish rush to build the Murman and Archangel broad-gage railways and develop these ports; also to build munition factories near

Paint sprayer for painting cars

the supply of fuel and iron. This demand for new construction, along with the unprecedented demand for munitions brought thousands of foreign traders to the country, all with the false expectation of getting wealth from the Russian Government.

During these days discontent was being promoted constantly by German propagandists, but, strange to say, the country never talked of defeat. It mumbled about a revolution after the war. The surprise of all was that the War Minister kept right on calling up the older classes of troops when the country was already over-mobilized. (Russia mobilized close to twenty millions of men), and munitions were available for only about one quarter of the troops. Afterwards the reason for this was evident. These men were kept idle in barracks and paralyzed production on the farms, in mines and in factories. They also became highly dissatisfied at the inaction and were an easy prey to propaganda. This was a part of the German plan to destroy the Russian morale and economic conditions through their influence with the Russian ministers.

All through the Summer refugees kept pouring into the interior of Russia from the front. Women in rags who had lost their children and all; children bereft of their parents; old men and women completely broken down by exposure, all lying on the sidewalks with no place to sleep, and all asking for alms. What were these people to do? The nation could not help them, their friends of low and high degree had lost their poperty, and could do nothing; the only solution was their assimiliation by the people of the interior, those remote enough from the front to still retain what little property and money they had before the war. This condition resulted in an unnatural congestion in the interior districts. This, along with the pitiful tales of the refugees, was an element in breaking down the morale of the people at home.

In September of 1915, I left Petrograd for Vladivostok to supervise the erection of the power house of an assembling plant for building American railway cars. This plant was to be built at First river, about three miles from the port of Vladivostok, and would have a maximum capacity of 160 cars per day.

I arrived in Vladivostok on the sixth day of October and looked over the ground where the plant was to be built. This was a swamp about three miles long by about a half mile wide, between two hills.

Things had quieted down on the battle front and as we were 6,000 miles away the atmosphere of war was almost entirely absent.

The Russians were to build this plant under my supervision and erect the cars under the supervision of representatives of the American firms who sold them. The first thing was to fill in this swamp, build railways, pipe lines, lay foundations, and commence building.

All of the assembling, lighting and power machinery was supplied by A. R. San Galli of Petrograd for whom I worked and to whom I was responsible for the installation and successful operation of the plant until 13,000 cars, the first order, were completed.

The plant was divided into five departments, each under a Russian engineer and all under a general manager, also a Russian.

The duties of the first department were to unload the material, assemble the wheel trucks, place the platforms on the trucks and deliver them to the second department. The machinery used here consisted mainly of ten and twenty-ton Brown hoists, and work was done entirely in the open.

The duties of the second department were to erect the steel work on the cars and put the air brakes and piping in place. This department consisted of five steel shops where the riveting was done and an open-air testing department for the air brakes. These steel shops used several hundred Little David riveters, chippers, holders-on, drills, and hoists, as well as a great quantity of coke and oil rivet forges. Reheaters were also used for reheating the air in each shop.

Church of the Resurrection, Petrograd, where Czar Alexander II, the "Liberator of the Serfs," was assassinated. The gates contain over twelve tons of sterling silver and inside is a cross of 32 aqua marines, each 1½ inches square.

The duties of the third department were to place the woodwork on the cars, put on the tin roofs and do the painting. Little David drills were used for wood-boring and tightening nuts. Pneumatic paint sprays were used for the wheel trucks and under frames. The car bodies were painted by hand. The wood-working shop contained the usual wood working tools and rolls for bending sheet iron.

The duties of the fourth department were to furnish compressed air, light and power and do repairing. It consisted of a power house, a machine shop and a blacksmith shop. The power house contained six locomotive boilers; four 500 H. P. Ingersoll-Rand compound, condensing steam driven air compressors; two 180 H. P. Erie City steam engines direct connected to General Electric direct current generators, and one 85 H. P. American Ball Engine direct connected to a General Electric direct current generator. The engines were each supplied with Wheeler low level jet condensers and the water for the compressors and boilers was supplied by Cameron steam pumps.

The blacksmith shop consisted of a number of forges and a 1,000 lb. air hammer.

The machine shop was equipped with a number of lathes, drills, and hydraulic wheel presses.

There were 1,000 arc lights and several thousand ordinary lamps in the lighting system.

The fifth department handled administration, housing, employment and testing and accepting the finished cars.

There was also another department for unloading boats and bringing material the three miles from the water front to the erecting plants.

The cars consisted of 4,000 gondolas and 9,000 box cars furnished by the Pressed Steel Car Co. of Pittsburgh, the American Car and Foundry Co. of Berwick, Pa., and the Eastern Car Co. of Canada. Representatives of these companies were on the job constantly.

We commenced work on the 7th day of October and had the first compressor in operation by January 4th. The other units were put into service in rapid succession. I was ably assisted in my work by two Americans William T. Piper, and William N. Scott. Engineers will understand what a difficult undertaking the erection was when they consider that the engines were assembled and placed on foundations without the use of a single crane, the only rigging material we had on hand being a small pulley block, hand winch, and four locomotive jacks.

During the time we were erecting the engines the buildings were being built around us. It took six weeks to a day from the time the foundations were started until the four air compressors were completely erected and grouted in. To give some understanding of the foundations required for these heavy machines I wish to explain that we built one solid floor four feet thick of rough concrete, reinforced by barbed wire, which extended the entire length of the power house. On top of this floor were erected the foundations for the engines.

Now came the job of laying about six miles of compresed air lines, ranging in size from 1½ to 10 in. in diameter, putting in steam piping, condensers, and the thousand and one other things necessary to get the plant started. Our piping had arrived with the exception of the larger fittings, valves, flanges, and pipe tools, the ship carrying them having been lost at sea. However, we could not hang up the work for want of this material as there were half a million tons of munitions which were badly needed at the front lying on the docks at Vladivostok and cars must be had at any cost. We made over 50 square and irregular bends in pipe of 6 to 10 in. diameter. We hadn't any pipe threading tools so we fixed a foot-treadle on a lathe and let Chinamen furnish the power for operating it. We also made chain tongs for pipe work and heated

the ends of the large pipe and turned up Van-Stone flanges which we finished off with files. The flanges were made from steel rails; tees were also made from pipe by cutting a hole and riveting on the tee piece. We connected up the whole lot of engines without any valves, except the throttles on the engines and boilers. Short pieces of pipe were placed in the lines and these were removed without disturbing the pipe as fast as the valves were received. Some of these valves, however, did not arrive until the shop was completed.

In short, we accepted no excuse whatever for want of material and forced the thing through to completion, notwithstanding that it was necessary for us to make several new steam valves and one new crosshead on the job.

The day after the first car was erected we took a holiday to attend the Russian ceremonies which included religious service and a banquet afterward. Although prohibition was in force we had plenty of champagne and then some flowery speeches. It is well to note that prohibition in Russia was every bit as effective, if not more so, as war-time prohibition in the States.

Production gradually grew from a few cars a day in January to 164 a day in June, when it fell off again on account of shortage of car parts.

The first 13,000 cars were completed by September when we had another banquet and a religious service. Soon after I turned the plant over to the Russian Government.

This account would not be complete if I did not say a few words on behalf of the Russian workmen and mechanics. On this job and on all the other jobs with which I was connected in Russia I found them very capable workmen. True, they are slow to understand a thing, due to their complete lack of education, but once they understood what they were to do they did it well. The carpenters and mechanics especially were clever workmen and if they had confidence in the man who gave them directions they could do almost anything that one could wish. However, the Russian engineer was altogether too theoretical. He believed in always looking for a precedent and considered it a disgrace to pick up a wrench, or dirty his hands in any way. I found this true everywhere in Russia and especially on this Vladivostok job. They were amazed at the way Americans forced things through and we had heated arguments and differences with them on this account. However, they were clever in many respects and when a thing was finished and working they were quick to see the good points. All theory and no practice is one reason why Russian engineers have never made the headway that other engineers have.

Another point wherein they are weak is in administration and this applies not only to the engineers, but to every other class of Russian executives. Just as sure as several Russians try to administer any proposition jointly, differences arise and there are lengthy discussions and untold trouble. They must have a single administrator to lay down the law. This was forcibly brought to my attention by the fact that on this job the first and second departments could not get along on account of the close association of their work. It finally became so bad that the heads of these two departments communicated with each other through the general manager.

While here I placed an Ingersoll-Rand submarine drilling outfit in the Golden Horn Harbor for excavating a shelf in the sloping rocky bottom so that a concrete pier could be laid down.

In November I returned to Petrograd. By this time the rumblings indicating revolution had penetrated to the farthermost corners of the Empire, thanks to the German propagandists who were still everywhere busy. Their agitation at this was against the Government, claiming that it was pro-German and that General Brusiloff had been told to stop the Gallician offensive and that Roumania had been betrayed, which was all too true. They also said the war could never be won unless a change was made in the government. Transportation had become so bad and dissatisfaction was so rife that no one who traveled and talked with the people doubted that a revolution was a certainty.

Things went from bad to worse. The monk, Rasputin, of whom much has been written because of his pro-Germanism and influence at the Russian court, was murdered and his body thrown in the Neva River. A general strike was pending in Petrograd and this came on despite severe warnings from the government that the strikers would be mobilized and sent to the front. The police undertook and failed to break up the crowds that collected on the streets. They ordered the garrison out to shoot into the crowds and these soldiers mutinied and refused to go. This mutiny spread like a flame and the revolution was on in earnest. Able and loyal men took up the reins of Government, patriotic speeches were made and the soldiers marched and played the Marseillaise. It was decided to proceed with the war and reorganize the government on democratic principles. In fact, much was said on this subject of Democracy and the Russians had many plans to organize a government which would be much more efficient than any of the other Western democracies.

The soldiers made speeches on the streets, telling the people to guard their freedom and that they would proceed to the front and finish the war. However, this was not to be because German propaganda and German gold now took on a new form of activity. The frontiers were open, Lenine and hundreds more of his type arrived continually from abroad, all well supplied with funds. They bought printing-presses, seized public buildings and started active propaganda against the new Government, calling them capitalists in collusion with the Entente. They advised against the prosecution of the war. "Peace and Freedom" was their slogan and they rapidly gathered a following and sent their scouts to the front and to all the industrial districts of the Empire. These agitators would get on trains conveying soldiers to the front and at each station their converts would take their guns and start home, so that many trains arrived at the front practically empty.

Kerensky had issued his now famous order Number One, and no one feared punishment for desertion. Soldiers' committees were formed and distrust was sown against officers. Agitators would go into factories and order the workmen out on the street for demonstrations. I once asked a workman from the arsenal why he was out on the street and he said he did not know, that he was ordered out and given ten rubles to go with the privilege of being shot if he remained.

The soldiers at the front were told to fraternize with their "German brothers" as the propagandists called them. From now on it was evident to many of us that only a miracle could save Russia. The women formed a battalion, trained and started for the front to see if they could not shame the soldiers into continuing the war, but this also was a failure as was Kerensky's ill-fated offensive on the Gallician front. Whatever may be said of the Women's Battalion, I want to assure my readers that many good women were in it and their motives were of the highest. The defeat that followed the Kerensky offensive was

Complete frame work of the first box car assembled. An elaborate ceremony was held on completion of the car.

decisive. The army was so badly demoralized that it put to shame the deeds of the Germans in Belgium in its retreat. I made a translation of General Gouchkoff's report of this retreat and the atrocities committed by the Russian soldiers on their own people were unbelievable. These atrocities were later confirmed to me by members of the English tank corps who were on that front at the time.

Following close on the heels of this retreat a new revolution broke out in Petrograd, known as the First Bolshevik Revolution. This was much fiercer than the revolution of March when the Czar was overthrown, but was finally put down by an echelon of Cossacks from the front.

ly called him a traitor. It now became evident that he was fast weakening and that there would be a second Bolshevik revolution in the near future with the chance in its favor. This was scheduled for the 25th of September, the day I left Petrograd for America but it was put off until November when it came on with such force that it overthrew Kerensky and made him a fugitive. If he had only listened to advice, Russia would now have quite a different part in history.

Whatever may be said of the Russians, I have only sympathy for them. This nation has been held down in slavery since time immemorial. Ninety per cent. of the people are uneducated and were not allowed the

sheviki and that they were happier and had more freedom under the Czar than they have now.

No matter what Lenine and Trotsky may do, they are destined to failure because they have not taken human nature into consideration. It is the inborn desire of every human being to have something all his own and the Russian is no exception to this. Furthermore, the work of reconstruction will get too big for a few men to handle and saner elements will work into the Government as, in fact, is already being demonstrated. It will take time, but it is inevitable, and some day Russia will take its place among the great nations. What they need most is to be let alone

Compressors being installed at railway car plant. Government engineers are in uniform. The main power house is 840 feet long

With the exposure of his insidious propaganda Lenine now went into hiding and the loyal people demanded his arrest. Things were quiet for a little while, but it was evident that the German agents were still busy and that they only waited for a break between the Kerensky crowd and the Korniloff crowd. This break was assured after the all-Russian Congress met in Moscow. Korniloff marched on Petrograd during the latter part of August by a supposedly prearranged plan with Kerensky, but when he was on the outskirts of Petrograd was surprised by Kerensky troops and defeated. This was aired as treachery on the part of Kerensky to get Korniloff out of the way and gain more power for himself by having defeated a monarchist and saved the revolution. Instead of making Kerensky stronger this made him weaker because the Korniloff followers openprivilege of education. Millions of them were sent to the front ahead of their own machine guns and forced to fight with clubs and stocks for weapons against well equipped enemy troops while their families were worse than starving at home. They had as much to do with winning the war for civilization as any other nation and this credit should be given them, notwithstanding their present condition. They were ignorant, defeated without any battle by the betrayal of their Government and demoralized within by propaganda. The world looks on and censures them for falling victims to Bolshevism. This is wrong—we should not expect any uneducated class of people to understand modern government as their minds are incapable of knowing what it all means and the result is that about the only thing they know is that, before, they were ruled by the Czar and now by the Bolto work out their own salvation, but will they be let alone? The warring nations should make peace with Bolshevik Russia and guard themselves at home against propaganda. Trade should be carried on whenever possible, and above all the allies and the United States should keep a close watch to see that Germany does not get control of Russia.

In conclusion here is some excellent food for thought. The Bolsheviks were financed and directed by Germans in 1917. That is a known fact. What is Germany's position today with respect to them? Is not this Bolshevism a part of some nefarious scheme on the part of Germany? She could not be trusted before. Can she be trusted now? If Russia falls into the hands of the Germans, as present conditions would seem to indicate, is there not a larger and more disastrous war ahead for civilization to fight?

Reconstruction Days

Officials of the New York, New Haven & Hartford Railroad announced that the Board of Directors had chosen the following officers to serve the company under private ownership: President, E. J. Pearson; vice-president, and general counsel, E. G. Buckland; vice-president in charge of traffic, B. Campbell; vice-president, headquarters at Boston, A. P. Russell; secretary, Arthur E. Clark; treasurer. The other officers serving under Federal control will resume similar positions and the personnel of the executive force thus remains much the same as before the period of Government control.

Regarding the personnel of the management of the New York Central system it was not intended according to officials that there will be any radical changes and no adoption of the regional plan of control recently formed by the Pennsylvania Railroad.

The Baldwin Locomotive Works has received an order for 45 locomotives from the Great Northern Railway. The Union Pacific has ordered 35 and the St. Louis and Southwestern has ordered ten. Scattered orders for from one to two locomotives have been received from a number of the smaller roads.

Ample supplies of Chilean nitrate to meet farm requirements this season are assured for the United States under an arrangement made between the Department of Agriculture, the Shipping Board and nitrate importers for prompt action in supply tonnage.

It was announced recently that until July 1 the board will allocate the requisite tonnage and after that date importers will submit their sales on the first of each month, on which the board will make further agreements for vessels.

Deliveries were somewhat delayed in February, March and April, but nitrate handlers believe that they will receive May and June deliveries in time to clear up all shortages.

Deciding that in future wars the navy will confine its operations entirely to the water, the joint Army and Navy Board at a recent meeting recommended the transfer to the army of seven railway mounts for 14-in. rifles, which were manufactured for the navy during the World War. Favorable action was taken on the recommendation. Some of the transferred mounts were in actual service on the western front.

Nation-wide reports from Federal Reserve Bank officials, made public recently, disclose their opinion that the post-war era of "extravagance and reckless buying" by the public is nearing its end.

A "hesitation, if not an actual recession" of prices is noted, and the Federal Reserve Board's statement summarizes its advices as indicating a generally more hopeful view of the country's business condition than for several months.

From *Speed Up.*

THE SIN OF ABSENTEEISM

Loss of Time Alone Cuts One-sixth of Possible Output in Country's Industries

While the price changes are shown by the board not to be universal, they are, nevertheless, regarded as positive and of importance as a basis for reckoning what the immediate future holds.

Relief from the high prices for the consumer will not be completely obtained until present stocks are absorbed in practically all lines, according to the board's view. Manufacturers everywhere, however, were shown to hold the view that the peak of high prices has been reached and to expect a gradual recession.

Notes of Industry

The commission appointed by Governor Smith of New York to inquire into the advisability of establishing rules and regulations for air traffic over the state of New York, resumed its sessions recently. One of the speakers F. G. Browne of the Beardmore Motors Company, Ltd., of England, at a meeting held at City Hall, declared it was an obligation which New York could not evade to encourage the development of aviation as a passenger and freight service, and then added his belief that it is to become eventually the great terminus of the world. It will be from New York that airplanes will leave on a regular trade route to South American ports, he said. European countries do not possess advantages equal to those of the United States, Mr. Browne continued. He recently visited most of the overseas nations only to find they do not present the possibilities revealed by his inspection of America. Japan and China, he said, show a greater air development than this country.

During his talk with the commission Mr. Browne predicted the crossing of the Atlantic "a good many hundreds of times" within the next year. The Vickers Company is already preparing routes and machines for regular crossings.

William R. Grace & Co. have purchased through a subsidiary company known as the Brooklyn Terminal Company 84 and 86 Pearl Street and 50 and 52 Water Street, New York. The property, which was sold by James A. Glover, consists of three five-story loft and store buildings covering a plot of 5,600 square feet with frontages of 36.9 feet on Pearl Street and 42 feet on Water Street.

The buyers hold title to the Grace Building at 3 to 13 Old Slip. With the property just purchased a total frontage on Water Street of 253 feet has been secured by W. R. Grace & Co. and their plottage increased at this point to nearly 33,000 square feet, which is the largest and one of the most important plottages under one ownership in the financial district.

Of sixty-six reporting cities forty-four show an aggregate increase of national bank deposits of $297,911,000. Twenty-two show an aggregate reduction of $84,526,000. Most of the increase was in New York, Chicago and St. Louis. In general deposits in Western States, except Pacific coast States, fell off. In Richmond deposits decreased $15,000,000; in Minneapolis, $12,000,000; in St. Paul and Denver, $7,000,000 each; in Boston, $6,000,000; in Cleveland, $5,000,000.

"The Chickasaw Shipbuilding & Car Company will build four additional ships of the Chickasaw type of ninety-six hundred tons dead weight, bringing the total number of ships on order up to fourteen." This was an official announcement issued by George Gordon Crawford, president of the Tennessee Coal, Iron and Railroad Company.

The annual convention of the Keystone Lubricating Company was held recently and attended by the district sales managers, district office managers and salesmen.

The convention was opened by an address by H. A. Buzby, vice president, on "The History of the Company." Another address on "Credit Relations," was given by W. F. Buzby, the treasurer. Then came a series of open discussions on service, sales and consumers technical problems.

The Chicago Pneumatic Tool Co. recently held a general conference of executives, plant and branch managers and salesmen at its Detroit plant, on the occasion of the formal opening of a large five story addition. A description of the system of service stations which the Company has opened was outlined in detail.

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Editorials

U. S. RAIL AND WATER ROUTES IN ECONOMIC RELATION

WATER BORNE commerce in the United States has had its ardent champions for many years, not because these proponents in viewpoint are by any means inimical to railway interests, but because they have concerned themselves with the economical side of fluvial, lake or canal transport. It is usually rather a thankless task to compare rail with water transportation. Conclusions reached are frequently unsatisfactory to the student, and the practical transportation man knows that conditions vary so between water and rail transport territories considered that it is difficult to reach proper analogies.

Railroad men have always been prone in some degree, perhaps naturally enough, to make out a dubious case for water transport, possibly because they have classed it indiscriminately as in "competition" with rail lines. That, of course, is where one encounters the human, business element, which is not always concerned with economics.

An editorial in these columns, published in the February (1920) issue, has attracted considerable attention and comment on the part of transportation experts, since it had to do with the project of opening the Great Lakes to the sea, which really means the opening up of a continent to ocean traffic by means of an "American Mediterranean." Two presidents of great railroad systems in America have written COMPRESSED AIR MAGAZINE to express their views on waterways in general, but neither of these gentlemen took up specifically the merits or demerits of the Great Lakes-St. Lawrence tidewater project.

Mr. SAMUEL REA, head of the great Pennsylvania Railroad system, in his interesting letter advances the general proposition that:

"Where a short artificial waterway saves thousands of miles of sea distance, as do the Suez and Panama canals, it is economically cheap at almost any cost. The Welland and Soo canals are on a small scale short links in long natural water routes.

"I am not averse to the development and improvement of natural waterways, but long artificial waterways and even improvements of natural waterways should be considered in a comprehensive way and every effort made to prevent them from becoming costly and wasteful monuments of partisan politics, and objects of criticism from other countries who plan, carry out, and operate canals where they are absolutely beneficial.

"A fair criticism from the standpoint of the railroad investor is that when Government work of this character or other methods of transportation are carried out and they are a failure, the cost of the failure is charged up against the citizens and especially against the transportation companies, and the latter are then accused of conducting a costly transportation service."

Mr. REA is no doubt referring to past sins in "pork" projects supposed to cover river and harbor improvements, and there is a great deal of truth in what he says. In his letter he goes further and discusses the unsatisfactory outcome of the Mississippi River navigation plans of the United States Railroad Administration, which made a $12,000,000 appropriation; the losses in operation of the Delaware & Raritan Canal; and the unfortunate showing thus far made by the New York State Barge Canal system, which is equal in its total length to the Lehigh Valley and Lackawanna Railroad systems.

Regarding water transport as a whole in this country, Mr. REA believes that if it is to be successful in this country in the future, "it may have to be protected from rail competition as is done abroad, or perhaps with the increased cost of transportation the rail rates will become so high as to admit of water competition, but the same factors that enter into the increased cost of rail transportation—like labor and materials—will also increase the cost of water transportation."

There are undoubtedly instances in which water transport is not cheaper than it is by rail, as a general statement of fact, but there are usually reasons for this condition that do not by any means affect the soundness of projects for water transport, such as the Soo, the Welland, the Panama and the Suez Canals, or the justification for the comparatively slight expense of say $250,000,000 involved in bringing ocean navigation to the heart of North America, by means of the logical St. Lawrence route. In the first place, engineers argue, Great Lakes transport and a continuation of it through the St. Lawrence, is not the same as river or canal transport.

According to a lengthy article in *The New York Times* of March 28, in which most of the arguments for and against the St. Lawrence improvement are touched upon, there is a quotation to the effect that the Soo Canal, which cost $32,000,000, saved the country $180,000,000 in 1918 alone.

Before going further with this discussion, it may be helpful to consider, as briefly as possible, just what the St. Lawrence improvement project contemplates. It is 180 miles from Lake Ontario to tidewater; the first section being to the international boundary, a distance of 113 miles to St. Regis, over which the Joint High Commission has jurisdiction; the second section extending to Montreal, being in Canadian territory, and, if the undertaking is carried through, to be improved by the Canadian Government, which is soon to complete the Welland Canal improvements at a cost of $65,000,000.

Of the total distance it is estimated that 135 miles are nearly all navigable for ocean-going steamships. This leaves 45 miles to be improved in which the large item of expense is for the rapids. Roughly the cost has been divided as $100,000,000 from Lake Ontario to the international boundary, and $150,000,000 from the boundary to Montreal. The cost of the Panama Canal was something more than $400,000,000, which was higher than original calculations, but even if the estimates on the St. Lawrence project are exceeded, its best informed advocates declare, it will pay for itself over and over again, not only from the lowered cost of transportation, but from the sale of the total of 2,000,000 horse power to be generated in the St. Lawrence, about half of which would be sold at reasonable rates by the Canadian Government and the remaining half by the American Government. Both governments have declared that the water power rights will not be sold out to private interests, which are reported to have offered to bear the entire costs of the waterway improvements, provided they could have the distribution of the power.

It is argued for the St. Lawrence improvement, which will enable ocean steamships to steam from Havre or Liverpool direct to Chicago, Duluth or any other port on the Great Lakes, making each lake port a seaport, that it will effect a transportation saving of five cents a bushel on wheat, not only a direct saving, but an immense stimulation to farm production. Large areas not now within the margin of profitable cultivation in tributary states would be brought into production.

The rate of growth of the West, tributary to the centres on the Great Lakes and reaching to Montana, Idaho and Colorado, would be doubled, backers declare, and this growth would be reflected in the East, just as it always has been in the past. The greatest tribute

from new and larger markets would go direct to New York. Boston and other Atlantic seaboard cities would also benefit from the greater fluidity of freight movement, from the ease and economy of transport. As much as would be saved on wheat would be saved on other bulk exports, it is maintained. As it is now, these freights, in taking the water route through the lakes must break bulk twice, at Buffalo, and at New York, for ocean transshipment.

It is held to be a well known economic fact that freight hauls on the Great Lakes cost an average of one-tenth of a cent a ton mile, whereas rail rates average three-fourths of a cent a ton mile. It may not be a general truism that water transportation costs are invariably lower than rail transportation costs, where all the elements of the economic situation are considered. Engineers maintain, however, that it is scarcely beyond dispute that the St. Lawrence route would mean large freight haul savings, that it would moderate freight car shortages and relieve the rail lines of the less profitable freights, while on the other hand feeding them profitable business.

There is an honest belief that the St. Lawrence improvement will be helpful to American railroads, and not hurtful, and no student of the situation in possession of all of his reasoning powers desires to see our fine railway systems hurt. It is interesting to note that Mr. CHARLES WHITING BAKER of the *Engineering News-Record*, in his recent series of five fine articles concerning transportation in America, took up in some detail in his concluding article the St. Lawrence undertaking, upon which he placed his seal of approval. In his earlier articles of the series Mr. BAKER was at some pains to indicate his sympathetic concern, too, for the railway systems of the United States, presenting dispassionately and at length his very fair views based on his observations as an engineer, investigator and writer.

The shipper, the engineer, the citizen, each alike today seem to believe that the railroads are entitled to every pound of freight that they profitably and economically can handle with entire fluidity of movement, but what the railroads, the shippers and the public as a whole wish to see avoided is a congestion of terminals at the great necks of the transportation bottles, such as comes about with annual recurrent regularity at the foot of the lakes and at the Atlantic seaboard terminals. Incidentally the railroads have never enjoyed in this country's history a more friendly attitude from the public as a whole than is their portion at the present time.

We were much interested in a letter received from Mr. C. H. MARKHAM, president of the Illinois Central Railroad, who declares: "There is no comparison between the cost of moving tonnage on the Great Lakes and on any other known waterway." Like Mr. REA he challenges any assertion that as a general proposal water transport is cheaper than that by rail. He makes this clear and thoughtful statement:

"Competition with other nations in world trade is going to make it necessary for the people of this nation to take advantage of every opportunity to increase efficiency in all things affecting producing and manufacturing costs. Since transportation lies at the very foundation of commerce, what we ought to do is to make use of whatever instrumentalities of transportation are the most efficient and economical. If we have an interior waterway on which tonnage can be handled more cheaply than by rail, the two forms of transportation should be so correlated as to permit tonnage moving by the route which can handle it the most efficiently and economically. Naturally, the first thing to do is to ascertain which is, in fact, the most efficient and economical, and this information should be obtained in advance of spending hundreds of millions of dollars only to find, after it is too late, that the money has been wasted."

Mr. MARKHAM'S position in this matter is so sound as to constitute an axiomatic statement. Eminent engineers that have gone carefully over the St. Lawrence proposals for the Canadian and American governments have reached favorable preliminary conclusions, the Joint High Commission is empowered to hear all the facts and weigh all the arguments, and in the final threshing out, there is small doubt that the entire project will receive just consideration as to whether it is feasible, economical and for the best interests of the large sections of the North American continent it is intended to serve. In its essence it is a national, or rather international, and not a local, problem.

Most folk in New York that have taken the pains to study the matter from the national, and even the local viewpoint, believe that the project may help some day to relieve the congestion at the port of New York, where both too much freight and too many passengers are handled for New York's comfort and peace of mind. Many New Yorkers are rapidly coming to the conclusion that it is a questionable distinction and of questionable advantage to be the world's largest city. New York is suffering from growing pains that can scarcely be soothed in the next ten years before another census unless a couple of million of her inhabitants can be induced to spread out and take up their rest in other parts of the country where population is more thinly distributed.

To return to the railroads for a final word, it is learned that the Railroad Administration made a careful and thorough study of the freight car shortage and that accurate figures have now become available. The shortage, we learn from Washington, amounts to 500,000 cars, and if all the car-building plants in the country are put to work at capacity it will require two years to make good the deficiency in freight rolling stock. The car shortage in this country is a matter of annual discussion. It affects the cost of living to a much greater degree than many folk may surmise. Proponents of the American Mediterranean, as it has been termed, believe that the car shortage problem will be solved largely by means of the St. Lawrence improvement, saving the railroads vast sums in equipment. This would be no small gain for our transportation economics.

A recent commentary on the present position of the railways of America from a source that is accustomed to guide investors in rail shares, declares, that assuming reasonably favorable conditions as to earnings—and earnings available for dividends for the year beginning September 1, it is estimated, ought in the event of reasonably favorable developments to be about $534,000,000 compared with a pre-war high record of $515,738,500—it is indicated that for the first year when the railroads will have to stand on their own feet, they should be able without any increase in rates to earn a larger surplus for dividends than they ever earned before in times of peace. It is indicated as a larger surplus, however, only in absolute amount and not in percentage of capital stock. This conditionally indicated earning power also slightly exceeds another and earlier estimate of the surplus earnings required to equal a "fair return" defined and called for in the new railroad law.

Nor is the physical deterioration of perhaps $500,000,000 regarded as a very serious matter provided only the repair work now be done promptly. Most of the roads have already begun their rehabilitation work. Railroad authorities call attention to the fact that the roads always deteriorate in periods of unusual stress or in "hard times." In every past period of depression managements have neglected maintenance in order to make a better showing of surplus earnings, and have trusted to making it up in subsequent prosperous times. The amount of present deterioration is called large relatively; but it is small as compared with the benefits to accrue from the 36.6 per cent increase in rates, and from the new railroad law, which, as a matter of conjecture, will protect the railroads, no doubt, even from water competition if it ever becomes a menace to their welfare, which is extremely doubtful.

SHIP CONSTRUCTION FEATS AT HOG ISLAND YARD

THE ANNUAL report of Mr. CHARLES A. STONE, president of the American International Corporation, to the stockholders at the annual meeting April 7th, contains comment on the achievements at the great plant of the American International Shipbuilding Corporation at Hog Island in 1919, when "quantity production" of ships on a scale hitherto unexampled became a fact. In the course of the year there were launched 66 ships and 64 were delivered to the Emergency Fleet Corporation and immediately put into service.

This vast ship construction plant, the building of which was such a herculean engineering task, and one in which compressed air has played so prominent a part, produced a total tonnage of almost exactly half a million in a twelvemonth, a truly magnificent result.

Mr. STONE directs attention to the magnitude of this production by comparing it with the total tonnage of ocean-going steel steamers of more than 1,000 gross tons produced in the year ended June 30, 1916, in the United States. In that fiscal period the output of all American yards amounted to 304,000 deadweight tons. Thus the Hog Island yard alone in 1919 turned

out 196,000 tons of shipping in excess of what was produced in the entire nation in the fiscal year of 1916. It is noteworthy, also, that in the last six months of 1919, the Government took over 39 ships from the yard, showing a rate of production equal to more than 600,000 tons per annum. These results were obtained in the face of adverse labor conditions, with the yard undermanned. In fact, fully manned the yard has demonstrated itself to have a capacity to deliver a million tons of shipping a year!

The Shipbuilding Corporation takes pride in the circumstance that every ship built at the Hog Island yard has received the highest possible rating from the American Bureau of Shipping, and all have shown themselves in service to be thoroughly good steamships. The "Hog Island fleet" in 1919 traversed more than 900,000 sea miles and did this without any mishap chargeable to defect in construction or equipment; the ships in short, have fulfilled all expectations, Mr. STONE announced in his report.

This record would certainly seem to furnish a demonstration of the correctness of the theory upon which they were constructed, and also to indicate the perfection of design and efficiency of the Hog Island plant. The American International Shipbuilding Corporation's president, an engineer of note in America, does not hesitate to assert that the "fabricated ship" can no longer be considered an experiment, but must be regarded as a proven success.

Mr. STONE declares, too, that in another sense the Hog Island yard has given an excellent account of itself, and that is in the matter of operating efficiency. As is well known, the shipbuilding forces employed there had not merely to be collected; they had to be educated for their task and they had to be welded into a great team. How well this was done is shown by the production records at the yard. For the first six months of 1919 there were launched 27 ships and there were delivered 25. This gave a weekly record of almost one ship per week delivered and rather better than one per week launched. In the second six months of the year there were launched 39 ships and 39 were delivered—being an average of one and one-half launchings and one and one-half deliveries every week.

The records of riveting are particularly interesting. When shipbuilding began in earnest at the yard in the summer of 1918, the average number of rivets driven per gang per hour was about 20. For the first six months of 1919 the average was about 26, but in the last half year a marked gain was shown. In July the rate was 27, in August 32.7, in September 36, in October 35.9, in November 36.2 and in December 37. In January, 1920, the average rate was 39.6; for the first two weeks of February it was over 43 and has been as high as 45 for several days consecutively. These figures show that the corporation was able to develop at Hog Island a highly competent force of shipbuilders. Such results, moreover, would not have been possible without coöperation and team work of the first class on the part of all engaged on the work.

As illustrating the possibilities of quantity production and what can be accomplished by training men for work of this sort, it is interesting to note that the first ship, the *Quistconck*, built on Way No. 1, required 1,160,000 man-hours; the second ship built on the same way, and identical with it, required 601,000 man-hours; the third ship on the same way, and identical in all respects, required only 400,000 man-hours.

The coming summer will see the completion of the corporation's contract at Hog Island calling for the construction of 110 ships of the "A" class and 12 ships of the "B" class. The American International Corporation's principal contribution to America's war task was one that will be accounted as worthily representing that resourcefulness and energy which is regarded as peculiarly typical of the American character. The company is to be congratulated on its engineering achievements in constructing so brobdingnagian a plant under the most discouraging early conditions, and upon the production record which the plant has made.

ECONOMICS OF THE PEACE AS VIEWED BY KEYNES

SMALL WONDER it is that so intimate and frank a discussion of the results of the Peace of Paris, affecting as it does the nations and the very life of whole peoples, and constituting a documentary fate handed down by a few men debating on a diplomatic stage amid those panoplies and trappings of statecraft so well understood by the French, should so have taken the world by storm as has the volume from the pen of JOHN MAYNARD KEYNES, C. B., Fellow of King's College, Cambridge, entitled *The Economic Consequences of the Peace*. Before going to Paris, Mr. KEYNES had been the head of the department which dealt with all questions of British and foreign finance in all her financial relations with the United States and other Allies. He accompanied Lord Reading to Washington as financial advisor in 1917. He is now professor of economics of King's College, Cambridge University.

The message of this book has swept as a flame of thought through the world, evoking innumerable opinionative discussions in the more thoughtful newspapers and periodicals that have been uncommonly unlike one another. In America, KEYNES became overnight a prevailing topic of conversation in clubs, hotels, debating societies, Pullmans and homes. He has stirred national political circles by penetrating to the more hidden recesses of the international economic fabric. On reading the KEYNES book one wishes to have been behind the library portieres when it was read by some of the men in high place whom it discusses—CLEMENCEAU, LLOYD-GEORGE, WILSON. One can only surmise regarding its effect upon the small armies that formed the entourages of the national leaders, who, with scant consideration for "covenants openly arrived at," proceeded in their months of effort to "negotiate" a Star Chamber peace.

The book does not bear the earmarks of a pure theorist; indeed it could not, for the writer was attached to the British Treasury in the course of the war, and was the official representative of that department at the Paris Peace Conference up to June 7, 1919, also sitting as Deputy for the Chancellor of the Exchequer on the Supreme Economic Council. He writes as one who saw, and as a man who resigned from the posts mentioned when it "became evident that hope could no longer be entertained of substantial modification in the draft Terms of Peace." The grounds for his very vigorous objections to the treaty, or rather to the whole policy of the Conference towards the economic problems of Europe, are set forth publicly in his tremendously interesting book as "based on facts known to the whole world," although we must confess at this distance to previous unenlightenment on many of the most vitally important points discussed by Mr. KEYNES.

One is enabled to see why economics is called "the dismal science" in following his clear reasoning. The average American, at least, will be prone, however, to accept many of his points with sympathetic understanding. In the subjoined indictment it will instantly be noted that Mr. KEYNES does not include the spokesmen for the American people:

"Moved by insane delusion and reckless self-regard, the German people overturned the foundations on which we all lived and built. But the spokesmen of the French and British peoples have run the risk of completing the ruin, which Germany began, by a Peace which, if it is carried into effect, must impair yet further, when it might have restored, the delicate, complicated organization, already shaken and broken by war, through which alone the European peoples can employ themselves and live."

After noting that France, Germany, Italy, Austria and Holland, Russia and Roumania and Poland "throb together, their structure and civilization * * * essentially one," our author declares that if the "European Civil War" is to end with France and Italy abusing their momentary victorious power to destroy Germany and Austria-Hungary, now prostrate, they invite their own destruction also, being so deeply and inextricably intertwined with their victims by hidden psychic and economic bonds.

It is found that an Englishman, for instance, and "England still stands outside Europe," who took part in the Conference of Paris and was during those months a member of the Supreme Economic Council of the Allied Powers, was bound to become, and for him a new experience, a European in his cares and outlook. There, at the nerve centre of the European system, his British preoccupations must largely fall away and he must be haunted by other and more dreadful spectres. Paris was a nightmare and everyone there was morbid. He found that a sense of impending catastrophe over-hung the frivolous scene; the futility and smallness of man before the great events confronting him; the mingled significance and unreality of the decisions; levity, blindness, insolence, confused cries from without—all the elements of ancient tragedy were there!

Almost hourly reports were received of "the

misery, disorder, and decaying organization of all Central and Eastern Europe, allied and enemy alike," financial representatives of Germany and Austria presenting "unanswerable evidence of the terrible exhaustion of their countries." After receipt of this sort of official intelligence, "an occasional visit to the hot, dry room in the President's house, where the Four fulfilled their destinies in empty and arid intrigue, only added to the sense of nightmare."

London believed Paris was making a great confusion of its business, but remained uninterested, and in this spirit the British people received the Treaty without reading it. The book, however, is written under the influence of Paris, not London, by one who though an Englishman, feels himself a European also, and who declares as a preliminary, that because of too vivid recent experience he is "unable to disinterest himself from the further unfolding of the great historic drama of these days which will destroy great institutions, but may also create a new world."

Chapter III describes the inner workings of the Conference in a way it has never hitherto been portrayed publicly, in our cognizance. KEYNES describes with the utmost frankness the personal factors that influenced the economic and financial provisions of the Treaty of Peace with Germany, which still remains unaccepted by America. His book is likely to have its effect on American public opinion. He "assumes sometimes the liberties which are habitual to historians" in describing the parts played by CLEMENCEAU, "by far the most eminent member of the Council of Four;" President WILSON, Mr. LLOYD-GEORGE and Signor ORLANDO. Our readers will take his sometimes complimentary and charitable estimate of the President from the book itself, as they will his picture of the "unerring" six or seven senses of LLOYD-GEORGE in judging character, motive, even subconscious impulse, and in "perceiving what each was thinking and even what each was going to say next, and compounding with telepathic instinct the argument or appeal best suited to the vanity, weakness, or self-interest of his immediate auditor."

Because of the leading part played by CLEMENCEAU for the French in those parts of the Treaty with which Mr. KEYNES concerns himself, the picture of the Premier is of more than passing interest, for it gives a clue to the actual outcome of the Conference as estimated in the later chapters:

"* * * He had taken the measure of his colleagues. He alone both had an idea and had considered it in all its consequences. His age, his character, his wit, and his appearance joined to give him objectivity and a defined outline in an environment of confusion. One could not despise CLEMENCEAU or dislike him, but only take a different view as to the nature of civilized man, or indulge, at least, a different hope.

"The figure and bearing of CLEMENCEAU are universally familiar. At the Council of Four he wore a square-tailed coat of very good, thick black broadcloth, and on his hands, which were never uncovered, gray suède gloves; his boots were of thick black leather, very good, but of a country style, and sometimes fastened in front, curiously, by a buckle instead of laces. His seat in the room of the President's house, where the regular meetings of the Council of Four were held (as distinguished from their private and unattended conferences in a smaller chamber below), was on a square brocaded chair in the middle of the semicircle facing the fireplace, with Signor ORLANDO on his left, the President next to the fireplace, and the Prime Minister opposite on the other side of the fireplace on his right.

"He carried no papers and no portfolio, and was unattended by any personal secretary * * *. His walk, his hand, and his voice were not lacking in vigor, but he bore nevertheless, especially after the attempt upon him, the aspect of a very old man conserving his strength for important occasions. He spoke seldom, leaving the initial statement of the French case to his ministers or officials; he closed his eyes often and sat back in his chair with an impassive face of parchment, his gray gloved hands clasped in front of him. A short sentence, decisive or cynical, was generally sufficient, a question, an unqualified abandonment of his ministers, whose face would not be saved, or a display of obstinacy reinforced by a few words in a piquantly delivered English."

Mr. KEYNES observes in a footnote at this point that CLEMENCEAU alone amongst the Four could speak and understand both languages, ORLANDO knowing only French and the Prime Minister and the President only English, asserting that it is of historic importance that ORLANDO and the President had no direct means of communication.

"But speech and passion were not lacking when they wanted, and the sudden outburst of words, often followed by a fit of deep coughing from the chest, produced their impression rather by force and surprise than by persuasion. * * * Throned, in his gray gloves, on the brocade chair, dry in soul and empty of hope, very old and tired, but surveying the scene with a cynical and almost impish air. He felt about France what PERICLES felt of Athens—unique value in her, nothing else mattering; but his theory of politics was BISMARK'S. He had one illusion—France; and one disillusion—mankind, including Frenchmen, and his colleagues not least. * * * His philosophy had, therefore, no place for 'sentimentality' in international relations. Nations are real things, of whom you love one and feel for the rest indifference—or hatred. The glory of the nation you love is a desirable end,—but generally to be obtained at your neighbor's expense.

"* * * Prudence required some measure of lip service to the 'ideals' of foolish Americans and hypocritical Englishmen; but it would be stupid to believe that there is much room in the world, as it really is, for such affairs as the League of Nations, or any sense in the principle of self-determination except as an ingenious formula for rearranging the balance of power in one's own interests."

CLEMENCEAU stood for a Carthaginian Peace, not a Peace on the Fourteen Points, by which he made no pretense of binding himself. The whole purpose of the KEYNES book is to show that a Carthaginian Peace is neither *practically* right nor possible.

Throughout his long treatise on the reparation required by the Peace, KEYNES presents the views of President WILSON on what the Treaty should have been, and then indicates what it became in the final draft, the humanitarian and idealistic principles of the President having been swept aside. At the end he found "the hand of BISMARCK (in 1870) was light compared with that of an Ally or of an Associate."

As to economics, the former British Treasury representative comes out bluntly in discussing remedies for a Peace which he deems absolutely impossible of fulfillment either by the Central Powers in making reparation, or by the Allies in repaying America except under a crushing burden. He believes in modifying the terms with Germany and Austria and he announces himself strongly for a voluntary cancellation by America of the debt owing from the Allies, in round figures ten billions, and by Great Britain of the debt owing from the nations to which it made loans. To the latter England loaned an amount equal to all it borrowed from the United States.

The war ended with every one owing every one else immense sums of money. Germany owes a large sum to the Allies; the Allies owe a large sum to Great Britain; and Great Britain owes a large sum to the United States. The holders of war loans in every country are owed a large sum by the State; and the State in its turn is owed a large sum by these and other taxpayers. The whole position is summed up as in the highest artificial, misleading and vexatious. "We shall never be able to move again unless we can free our limbs of these paper shackles."

KEYNES observes that a debtor nation does not love its creditor, and it is fruitless to expect feelings of good will from France, Italy, Russia towards Great Britain or America, if their future development is to be stifled for years to come by the annual tribute which must be paid. There will be incentive for them to seek their friends in other directions. If these debts are remitted, it is felt, a stimulus will be given to the solidarity and true friendliness of the nations lately associated.

There is a significance that it is well to note in this passage:

"On the one hand, Europe must depend in the long run on her own daily labor and not on the largesse of America; but, on the other hand, she will not pinch herself in order that the fruit of her daily labor may go elsewhere. In short, I do not believe that any of these tributes will continue to be paid, at the best, *for more than a very few years.* They do not square with human nature or agree with the spirit of the age. If there is any force in this mode of thought, experience and generosity agree together, and the policy which will best promote immediate friendship between nations will not conflict with the *permanent interests of the benefactor.*"

According to this book the calculations of "diplomacy" lead us nowhere. A *revanche* by France on Germany, after half a century, and

because of France's sufferings in this war, will stifle the whole world (including France herself), not help it; exacting the pound of flesh in repayment of capital loans and interest will have much the same effect while it goes on, and finally payments will stop anyway.

"The impulse which, we are told, is now strong in the mind of the United States to be quit of the turmoil, the complication, the violence, the expense, and, above all, the unintelligibility of the European problem, is easily understood. * * * But if America recalls for a moment what Europe has meant to her and still means to her, what Europe, the mother of art and knowledge, in spite of everything, still is and still will be, will she not reject these counsels of indifference and isolation, and interest herself in what may prove decisive issues for the progress and civilization of mankind? * * * We have been moved already beyond endurance, and need rest. Never in the life time of men now living has the universal element of the soul of man burnt so dimly. For these reasons the true voice of the new generation has not yet spoken, and silent opinion is not yet formed. To the formation of the general opinion of the future I dedicate this book."

Mr. KEYNES wrote his book, as a humanitarian as well as a professional economist, with an eye to the practical effects of the Peace Treaty. Among his proposed remedies to restore the crushed nations now starving slowly and without credit or raw materials is an international loan of one billion dollars, which is to be repaid with interest. He makes many valuable suggestions, reveals many circumstances having to do with the terms of the Peace that will be matters of new information to most of his readers, and takes in general a wholesome viewpoint on the subject of ameliorative measures.

Some editorial reviewers of the work of Mr. KEYNES have made a disparaging estimate of him as a "sentimentalist." We believe the majority of readers in this country will have small patience with this criticsim. There was a small degree of sentiment shown apparently at Paris, and if a larger measure had been vouchsafed and more understanding good will evinced, there is not much doubt that the Treaty of Peace would not now be the bone of contention it is on this side of the Atlantic.

ENGLAND ADOPTS AMERICAN INDUSTRIAL POLICIES

ELECTRIC POWER industries of Great Britain, it is estimated, are wasting about 55,000,000 tons of coal annually, and at a time when the United Kingdom, at least, finds its fuel a precious commodity. This information is embodied in an astonishing report, *British Industrial Reconstruction and Commercial Policies*, prepared by FRED W. POWELL, a trade commissioner of the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, Washington.

The cause of this waste lies largely in lack of centralization and standardization, Mr. POWELL reports.

"In the area of London alone," he says, "are 70 authorities that supply electricity to the public, owning 70 generating stations, with 50 different types of systems, ten different frequencies, and 24 different voltages!"

The average generating capacity of the 600 establishments in England that sell electric current is only 5,000 horsepower each. This is about one-fourth the capacity of a generating plant of economical size. So unorganized is the whole electrical industry that "one can not purchase a simple electric bulb without specifying the particular type of socket" in which it is to be used. There is a strong movement in England to-day to divide the entire country into sixteen power zones, under the control of the Government, and gradually to replace existing plants by sixteen superpower stations, capable of supplying industrial power to the whole of England. This movement is the outgrowth of the conviction on the part of many officials that the electrical industry is the "key industry" upon which depends Great Britain's future position in the trade of the world.

The actual progress being made in industrial reconstruction in England is also discussed by Mr. POWELL, who spent six months studying the process of transformation at first hand. He indicates that great changes are being wrought in various branches of British industry and declares that American industrial management ideas are "abroad in the land."

Standardization, scientific management, industrial research, and the elimination of waste, are to the fore. Publishers are selling efficiency textbooks, manufacturers are making efficiency tests, and the services of efficiency engineers are in demand.

The old regime of "excessive individualism," which has so long been a prominent feature of British industry, is giving way before the new situation that has arisen since the war. The official encouragement which has been given to the growing tendency toward the formation of trade associations and combinations is no longer needed. Fearful of the people's interests, the committee on trusts of the ministry of reconstruction, has proposed measures to obviate the disadvantageous features of such combinations; and the Government is planning protective legislation.

The report discusses British Government policy as it has expressed itself in recent, pending and proposed legislation, particularly with reference to trademarks and patents, antidumping laws, encouragement of industrial research, protection of key industries, and the doctrine of imperial preference. These policies are to some extent the outgrowth of the shifting of the market for British goods as a result of the war. Formerly, western Europe was Britain's best export field; but, while the need of manufactured goods in this market is enormous, until the economic situation becomes again stabilized, western Europe may be expected to attract foreign investments in preference to foreign goods. This makes it necessary for England to cultivate, to a greater extent than ever before, her trade with distant parts of her Empire, and also to extend her trade in South America and in the Far East.

"It is doubtful," says Trade Commissioner POWELL, "whether the best informed person knows to what extent the industries of Great Britain are prepared to reassert themselves as factors in world trade." But this uncertainty is likely to be dispelled this year as a result of three great industrial fairs, one at London, another at Glasgow, and a third at Manchester, Birmingham, at which all the leading industries of the country will be represented at their best.

AN ENGINEER TO STEER THE SHIP OF STATE

THE ORDINARY MAN in the street composing the great majority of the American people is continually being forced to his limit of endurance to keep apace with the rapid shifting of the scenes in the drama now being enacted on the American political stage.

When human events, after many years of normal sequence experienced a sudden change projected by the coming of the Great War, the minds of men became electrified by such a high voltage current that even the signing of the Armistice has not effected cessation or relief.

The League of Nations, the Peace Treaty, strikes, labor conferences, the Senate, Russia, varied brands of Bolshevism, the Irish Question and Prohibition have kept the mentality of the country keyed to the highest pitch to keep up with the accelerated pace of swiftly succeeding events.

National Democratic and Republican conventions, and a national election, are almost at hand. A host of issues present themselves, with no precedent or formula pointing a solution. And some politicians have tried so hard to keep both ears to the ground that they have apparently thrust their craniums deep into the sand.

Leaders at the Capitol find that never before has the interest of the man in the street been so keen in the issues which demand solution. Never in the last decade have the debates in congress been attended by such crowds.

One fact is conspicuously evident. The present state of affairs has stirred up thought among all classes, producer and consumer, merchants and professional men, capitalists and laboring men; and the outlook is increasingly brighter.

Labor will take a vital part in the next campaign—not only organized labor but the independent working man. Capital is very much concerned in the merchant marine, taxes, tariffs and similar important factors influencing its business.

There is a demand for wise and honest legislation. Perhaps the sun of the day of mutual understanding and respect is rising. "After the storm comes a calm" is an old maxim embodying the faith of the Pilgrim fathers.

Assuredly the most important domestic problems pressing for a solution are economic ones. The standards of living have been generally lowered among nearly all classes, which is only a natural consequence of the events of the last five years. Agricultural and mineral production, international obligations and trade, distribution of essential supplies and transportation are paramount considerations.

They are intimately connected with engineers and engineering and undoubtedly require essentially such a training and experience embodied in the definition "Engineering, the art of organizing and directing men and controlling forces and materials of nature for the benefit of the human race."

Looking over the list of past presidents of the United States reveals the fact that there have been fourteen lawyers, three soldiers, five teachers, two planters, one tailor and one publisher. Washington is classed as a planter but we also remember he was a surveyor and a soldier.

Engineers do not appear. However, this lack of precedent is no bar as little heed is being paid to tradition or precedent in the reconstruction of the economic fabric.

Is there not a real conscientious question arising in the mind of every patriot that a representative from the engineering profession is the best calculated person to "steer the ship of state?"

Operations in the oil fields of the United States (excluding California) during 1919 resulted in a large increase in completions and new production. There were 28,462 wells completed during the year, with total new output of 3,366,943 barrels, compared with 24,948 completions and 1,487,049 barrels new output in 1918. This is an increase of 1,879,884 barrels, or approximately 126%, in new production.

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Book Reviews

A GLOSSARY OF THE MINING AND MINERAL INDUSTRY, by ALBERT H. FAY, U. S. Bureau of Mines, Washington, D. C. With list of authorities. 750 pages. Price 75 cents. Washington, D. C.; Superintendent of Documents, Government Printing Office.

EVERY ONCE in a while a publication comes to our attention which is immediately recognized as possessing such value that it will remain in constant use for many years. This glossary by its well-known author will be welcomed by practical mining men, authors, editors and engineers who have long been subject to the existing lack of a comprehensive glossary of the mining and metallurgical industries. It contains about 20,000 terms; these include both technical and purely local terms related to metal mining, coal mining, quarrying, petroleum and natural gas and metallurgical works. The author has availed himself in the compilation of this volume of the exceptional facilities provided by the U. S. Bureau of Mines and its personnel. The list of authorities quoted is a long one, 138 in all, and include such familiar names as Hoover, Winchell, Ingalls, Young, Ricard, Weed, Kemp and many others.

To such much disputed terms as "apex," long the bone of contention in mining litigation and the loss of countless dollars to the litigants, nine different authorities are quoted, while the expression "Coal Dust" which has always possessed considerable latitude as to its exact meaning is defined in an extended discussion covering just what degree of fineness constitutes dust. About two pages are devoted to the definition of air and its mechanical applications.

The origin of words, particularly names of mining localities and properties, is given in certain instances. The well known Coniagas Mine in the Cobalt district of Ontario has derived its name from a combination of the respective chemical symbols of the metals recovered from its ore: Co, Ni, Ag, As.

The volume will take its place among other standard reference works in the engineers library and will prove an invaluable aid to the technical man who is required in the course of his professional duties to write reports or other data involving the use of technical phraseology peculiar to certain districts and of limited local application. For instance, "Dirt" is susceptible to five different interpretations according to the geographical location in which it is referred to. The author gives the following (1) England: Clay, bind or other useless waste produced in mining. (2) North of England: Foul air or fire damp—*Greeley.* (3) Wisconsin Zinc district: Ore or waste as broken in the mines. (4) Joplin, Mo.: Crude lead-zinc ore, the concentrate being called "Ore" and (5) according to *Skinner* dirt is auriferous gravel wash or pay dirt.

Mr. Fay has performed a distinct and meritorious service to the mining world for the painstaking care in which he has collected this material. Undoubtedly there will be numerous demands made upon the first edition and it is predicted that the supply will shortly be exhausted.—*E. P. M.*

STREET RAILWAY ACCOUNTING, A Manual of Operating Practice for Electric Railways, by IRVILLE AUGUSTUS MAY, C. P. A., vice-president of the American Electric Railway Accountants Association, comptroller of the Connecticut Company and auditor of the Berkshire Street Railway Company. Indexed and containing charts and specimen forms. 454 pages. Price, half leather, $5. New York: Ronald Press Company.

THIS is one of a series of standard works of the sort published by the Ronald Press Company for the benefit of preoccupied business men who demand their business literature shall be practical and to the point. In half leather and cloth, this bit of sensible bookmaking goes directly at the task of informing those accountants that specialize in street traction affairs. It makes no pretense of considering the theory of street railway accounting nor is it an encyclopædia of the various methods utilized by tramway companies. The work is rather an outline of the working methods developed and actually used by the accounting departments of certain large companies, which are operated in accordance with the Interstate Commerce Commission regulations.

Students of the industry will find in Mr. May's book workaday data based on long experience in the business. The writer has endeavored to center his attention upon the more important and troublesome phases of street railway accounting practice. He has, with good judgment, endeavored to extend aid to those who have tried to struggle along without guide or assistance in devising a system of accounts for a street railway company of complex organization.

CORPORATION ACCOUNTING, by R. J. BENNETT, C. P. A., director Bennett Accountancy Institute and member of Ontario Institute of Chartered Accountants, Pennsylvania Institute of Certified Public Accountants and American Institute of Accountants. Indexed and with charts, forms, etc. 563 pages. Tenth printing, 1920. Price, $5. New York: Ronald Press Company.

MANUFACTURING or industrial corporation executives and their head accountants, who may not have digested Mr. Bennett's very excellent work on corporation accounting practise, are sure to find it chuck full of sage advice, pertinent suggestion and practical, helpful methods adequately expounded. While the author draws attention to the fact that company accounting differs not greatly in its essentials from the accounting usual in other forms of business organization, he makes the point that there are certain transactions, accounts and entries employed in it which are either peculiar to the corporation or so seldom encountered elsewhere that they properly may be termed distinctive. It is with such distinctive transactions and their accounting treatment that the present volume concerns itself, and not with the general or more commonplace problems of accountancy.

The book is designed to help the corporation accountant to profit by the experience of those that have already grappled with and solved the unusual problems and it presents solutions and sets forth the established, tested practise.

The volume also devotes considerable space to details of corporate organization, practise and procedure which have a direct effect on the work of the accountant, all of this being important information essential to a proper understanding of corporate accounts.

Latest U. S. Patents

Full printed uncertified copies of specifications and drawings of any patent may be obtained by sending ten cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MARCH 2

1,332,239. MINE VENTILATOR. Elibert B. Tonnsen, Milwaukee, Wis.
1,332,293. AIR-PUMP. Courtney C. Hanger, Madisonville, Ky.
1,332,334. AUTOMATIC AIR-PUMP. Ralph Gregory, Kansas City, Mo.
1,332,363. AIR - CONTROLLING ATTACHMENT. Fritz Schwarzer, St. Gallen, Switzerland.
1,332,369. APPARATUS FOR MANUFACTURING GAS. William D. Wilcox, Chicago, Ill.
1,332,384. SHIP-RAISING APPARATUS. Michael Dray, Coatesville, Pa.
1,332,408. CONTROLLING MECHANISM FOR AUXILIARY - AIR AND THROTTLE VALVES. Dennis J. Pledger, New Orleans, La.
1,332,428. AIR-BRAKE. McKee Cooper, Asheville, N. C., assignor of one-half to Robert R. Reynolds, New York, N. Y.
1,332,516. ROTARY PUMP. Francis J. O'Donnell, Detroit Mich.
1,332,586. AUXILIARY AIR-SUPPLY DEVICE FOR INTERNAL-COMBUSTION ENGINES. Peter E. Yeager, Reading, Pa.
1,332,698. COMBINED VACUUM - PRODUCING AND BOILER-FEEDING APPARATUS. Guy Randall Vail, Battle Creek, Mich.
1,332,733. AUTOMATIC TRAIN - STOPPING MEANS. Fate Lyle, Benton, Tenn.
1,332,806. DIAPHRAGM-COMPRESSOR. Henri Corblin, Paris, France.
1,332,810. COMBINED AIR-SPEED METER AND ANGLE OF INCIDENCE AND SIDE SLIP INDICATOR, WITH DIAL THEREFOR. Oscar A. Danielson, New York, N. Y.

MARCH 9

1,332,897. BRUSH FOR SUCTION-CLEANERS. Howard Earl Hoover, Chicago, Ill.
1,332,895. PNEUMATIC - DESPATCH - TUBE SYSTEM. Charles P. Hidden, Brookline, Mass.
1,332,933. PNEUMATIC CUSHION. Edwin S. Sylvester, West New Brighton, N. Y.
1,332,943. HEATER OR SUPERHEATER FOR STEAM, AIR, OR GASES. Richard Hanson Cabena, Croydon, England.
1,332,996. PNEUMATIC BRUSH OR PRAYER. George Elliot Perry, Chicago, Ill.
1,332,995. AIR-PUMP. Conrad Nolda, Hastings, Nebr.
1,333,193. PNEUMATIC CARD-DISTRIBUTING MACHINE. Arthur S. Trew, Portland, Oreg.
1,333,279. TWO-STAGE AIR-LIFT PUMP. John Rigling, Philadelphia, Pa.
1,333,382. COMPRESSOR. Edouard Bruand, Villeneuve, Switzerland.
1,333,442. ARTESIAN-WELL-DRILLING MACHINE. Manuel Prado, Tacuba, Mexico.
1,333,461. VALVE-MOUNTING FOR MILKING-MACHINES. Henry B. Babson, Chicago, Ill.
1,333,488. INTERCHANGEABLE AIR-BRUSH. Rudolph F. Hamaker and William H. Virgin, New Orleans, La.
1,333,566. PUMP FOR SUPPLYING FUEL TO INTERNAL-COMBUSTION ENGINES. Bruno V. Nordberg, Milwaukee, Wis.

MARCH 16

1,333,627. APPARATUS FOR MINING PURPOSES. Edmund C. Morgan, New York, N. Y.
1,333,713. PNEUMATIC EJECTOR - PUMP. Burdett P. Hopkins, Clintonville, Wis.
1,333,753. COMBINATION FAN, COMPRESSOR, AND MOTOR-STARTER. Motoi Fujiura, Los Angeles, Calif.
1,333,774. AIR-COMPRESSOR. Albert B. Pedersen, Eureka, Utah.
1,333,833. PNEUMATIC SHEET - FEEDER. Carl E. Christophel, Pearl River, N. Y.
1,333,847. GOVERNOR-CONTROLLED AUXILIARY AIR DEVICE FOR INTERNAL-COMBUSTION ENGINES. Edward G. Hodges, Marshalltown, Iowa.
1,333,866. VALVE. Roy B. Maness, Gainesville, Ga.
1,333,913. AUXILIARY AIR-INLET FOR GAS-ENGINES. Richard A. Green, Chicago, Ill.
1,333,923. AIR-COMPRESSING MEANS. Aaron G. Jones, Hardwood, Okla.

MARCH 23

1,334,281. STORAGE AND UTILIZATION OF ENERGY BY MEANS OF LIQUIDS. Gogu Constantinesco, Alperton, England.
1,334,433. PNEUMATIC TOOL. Oscar J. Blake and Clyde Blake, Huntington, W. Va.
1,334,507. VALVE CONSTRUCTION FOR PUMPS. Harry L. Shartle, Walden, N. Y.
1,334,638. AIR-LIFT PUMP. Ralph H. Tucker, Los Angeles, Calif.
1,334,645. AIR-BREAK SWITCH. Ferdinand Bechoff and Maurice M. Samuels, New York, N. Y.
1,334,686. PNEUMATIC CHISEL. William Sidney Whyte, Bedford, Ind.
1,334,741. AIR-HEATING STRUCTURE. Patrick F. Dundon, San Francisco, Calif.
1,334,897. AUTOMATIC AIR-GAGE. James K. Greer and Caskie Curtright, Paris, Mo.

O. S. PICHER SUDDENLY DIES OF PNEUMONIA AT 45

At the time of going to press with the final form of the May issue of COMPRESSED AIR MAGAZINE, a telegram was received announcing the death at Chicago, on April 26, of Mr. O. S. Picher, President of the Eagle-Picher Lead Co., of pneumonia. His death means a great loss to the zinc and lead industries of America in which he had long been a leading figure. His passing at the age of 45, at the height of his powers as an administrator of big business, will be keenly felt among a large coterie of friends and business associates.

It is our impression that Mr. Picher was a native of California; at any rate, his early business training was had in California. He was a graduate of the law school of Columbia University, New York City. He had taken a leading part in the affairs of the Eagle Lead Company of Cincinnati, and later amalgamated it with his father's property, The Picher Lead Co. of Joplin, Mo., when he first sprang into greatest prominence in the lead and zinc field.

As referred to in an article in this issue concerning the Tri-State zinc district, it was he who backed the war-time development of the Oklahoma zinc field, and the thriving city of Picher, now containing 10,000 inhabitants, was named in his honor. Associated with Mr. Picher in the Eagle Lead Co. at Joplin were Mr. Marshall Evans and Mr. R. W. Evans, the latter having also died a year ago.

The zinc and lead mining operations of the Eagle-Picher concern in the Picher field were the largest in the territory. Mr. Picher, through his great energy and ability, built up the so-called Picher interests until they became a great ten-million-dollar concern. The company has a lead-oxide plant on the Passaic River in New Jersey, and the largest lead-oxide sublimation plant in the world at Joplin, Mo. The company also operates smelteries at Henryetta, Okla., and St. Louis, Mo.

The *Tech. Engineering News* is a new periodical which is published monthly by the alumni and undergraduates of the Massachusetts Institute of Technology and is devoted to a general review of engineering progress. Our contemporary possesses the advantage of having a long list of contributors composed of the alumni of the Institute which includes engineers of prominence in every industry and therefore has placed a wealth of information at the disposal of the editors. A few of the articles in the April issue are: "The United States Nitrate Plant, Muscle Shoals, Alabama," by W. B. West, Hydraulic Research Dept., M. I. T.; "The Federal Water Power Bill," by H. K. Barrows, and "The Relation of the Architect to the Engineer," by W. H. Kilham.

Patrick C. Boyle, president of the *Oil and Gas Journal* of Tulsa, Okla., and president and manager of the Derrick Publishing Co., died recently after an illness of six years. Mr. Boyle was born in County Donegal, Ireland, 74 years ago, and after serving in the Civil War he engaged in the publishing business in connection with the oil industry. In 1885, Mr. Boyle purchased the *Oil City Derrick* and later founded the *Oil and Gas Journal*.

The leather belting plant, office and business of E. R. Ladew, Inc., one of the largest leather belting concerns in the country, located at Glen Cove, has been sold to Graton & Knight, leather belting manufacturers of Worcester, Mass., according to an announcement. The deal, consummated Tuesday, involved several millions of dollars, it was said. All interests of the Ladew family controlled by Harvey S. Ladew and Elsie Ladew, Grace, wife of William R. Grace, are vested in the Worcester concern. The change was effective as of Feb. 1, 1920.

E. R. Ladew, Inc., was originally J. B. Hoyt & Co., Fairweather & Ladew, and was organized in 1846 in New York. The main plant was installed in Glen Cove in 1903. The plant employs several hundred men and is Glen Cove's principal industry. The Glen Cove Light and Power Company, a subsidiary, is not involved in the deal.

Travel Perils of an Editor

Bolling Arthur Johnson, editor of the *Lumber World-Review*, of Chicago, awoke recently on board a Pullman of an Illinois Central train from Memphis to find that in the night his trousers, containing $25 in cash, had been pilfered by some inhuman robber. As a result of vigorous telegraphing ahead, a squad of police and railroad officials met the train at St. Louis to provide relief for the trouserless editor. Meantime a train brakeman had administered first aid in the form of a pair of grimy overalls.

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